FOUNDRY TRADE JOURNAL

EST. 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 101
No. 2093
Registered at the G.P.O. as a Newspaper

NOVEMBER 22, 1956
Offices: John Adam House, John Adam St., London, W.C.2

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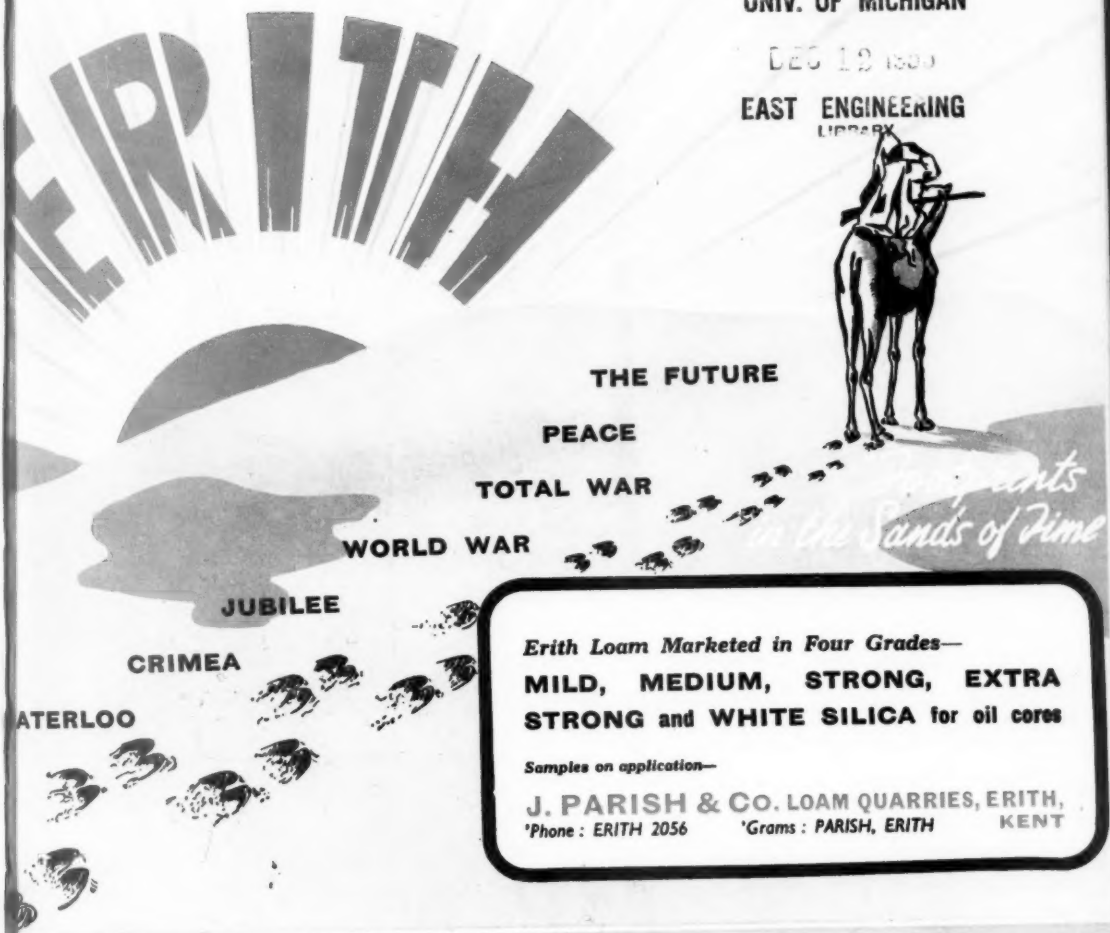

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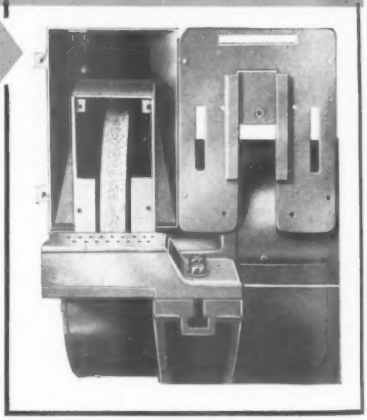

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Established 1902

Vol. 101 | Thursday, November 22, 1956 | No. 2093

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AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly

Single copies 9d.; by post 1s.
Annual subscription : home 40s., abroad 54s. (prepaid)

17/19 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacatecas, Rand, London.

What Next and Where ?

Since the Düsseldorf Congress, the foundry industry of this country has been giving much thought to a domestic exhibition policy. Various opinions as to the form this should take have already been expressed, and last week's successful regional *foundry* exhibition held in Sheffield has gone a step further in providing data on which to formulate such a policy. We have stressed the word " foundry " because it was much more than a display of equipment and supplies. There were exhibits from many of the large Sheffield foundries; from research associations and the like, and a very intelligent show was included of what the local apprentices had accomplished and how their training was planned.

The success of the Düsseldorf and Sheffield exhibitions —very divergent as to size—had one common factor. It was due not merely to co-operation (a word that too often passes for half-hearted patronage by one party) but to a real enthusiastic fusion of all the interests—the organizers, the stand-holders, the technical and lay public. In the case of the Sheffield exhibition, there was no profit motive involved and it is pleasing to learn that the accounts will virtually balance. The size of the exhibition, and the measure of its support from the equipment and supplies section of the industry, was comparable with the corner allocated for this purpose every fourth year in the Engineering and Marine Exhibition held at Olympia.

Pre-war, separately held exhibitions organized by the manufacturers of foundry equipment and supplies were not a great success, but since that time, the character of their business has changed from importing in a modest way to exporting on quite a large scale. Mainly because of the major difficulty of its housing, we know of no ready-made method of creating a really national foundry exhibition, much as we would like to see one. A second proposition, however—the organization of regional exhibitions—would seem easier to adopt, if local enthusiasm akin to that so evident in Sheffield could be generated, and there be suitable halls available in other foundry areas. Over a period, half a dozen such shows would do a very great deal to demonstrate the virility and progressive character of the foundry industry. For the lead given in Sheffield by Mr. J. F. Stanier, Mr. R. F. Horton, and Mr. J. H. Pearce, who with Mr. W. H. Bolton (of the Sheffield section of the National Trades Technical Societies) formed the Sheffield organizing committee, the industry is indeed grateful. As to the future, " what next and where " are urgent questions the industry has to face.

BSFA Customer/Founder Convention II

On Wednesday of last week at the Café Royal, London, the British Steel Founders' Association staged their second customer/founder convention. Well over 100 members and their chief customers, along with representatives of inspecting authorities, were partners in the day's proceedings. Mr. G. M. Menzies, chairman of the BSFA, presided, and the following papers were presented and discussed*: "Acceptance Standards," by A. C. Annis (Metropolitan-Vickers Electrical Company Limited); "Fulfilling Requirements," by Dr. C. J. Dadswell, B.SC.(ENG.), Ingenieur E.S.F., M.I.MECH.E., vice-chairman, BSFA and director, English Steel Castings Corporation Limited; "Steel Castings from the Surveyor's Viewpoint," by S. F. Dorey, C.B.E., F.R.S., D.SC., M.INST.C.E., M.I.MECH.E., chief engineer surveyor of Lloyd's Register of Shipping (in the absence of Dr. Dorey, this paper was read by a colleague, Mr. T. W. Bushell). Afterwards, in his final summing up Mr. Menzies, said that the most important outcome of the meeting was that all were agreed that there must be closer collaboration between them, and that this collaboration must not be confined to the discussion of difficulties only when they arose. All must strive to anticipate causes of such difficulties by tackling them when the design of parts which were to be cast were being worked out.

Luncheon

Association members were hosts at a luncheon between the sessions, also held at the Café Royal, and attended by a total of 150. Here, the chairman was accompanied at the high table by Mr. F. H. Crerar, C.B.E., A.D.C. (who organized the function); Mr. E. H. Bail, Mr. T. H. Summerson, Sir Steuart Mitchell, K.B.E., C.B.E., and Mr. F. Rowe, in addition to those who presented papers.

* It is proposed to publish abstracts from the papers and discussions in a forthcoming issue of the JOURNAL—Editor

Members of the British Steel Founders' Association and some of their guests at the Customer/Founder convention in the Café Royal last week.

Iron Industry Appointments

Mr. J. W. Butler has been appointed assistant director of the Joint Iron Council, the Council of Iron Producers and the Council of Ironfoundry Associations. Mr. D. L. Farrant has been appointed to the secretaryship of each of these three bodies.

MR. J. W. BUTLER

Mr. Butler has had a long connection with the iron industry. For ten years before the second world war he was engaged in technical editorial work including a period on the staff of the Foundry Trade Journal. After war service attached to the Royal Navy, in 1947 he joined the staff of the CFA as assistant secretary, becoming secretary a few years later and in 1956, secretary also of the Joint Iron Council. Mr. Farrant also served in the Royal Navy during and after the second world war. His new appointments come five years after joining the staff of the Council of Ironfoundry Associations.

Birmingham College of Technology

At a recent meeting of Council of the Guild of Associates of the College of Technology, Birmingham, a decision was made to form a London section of the Guild. There are at the present time about 35 associates resident in or around London, 28 of these being members of the Guild and nearly all these have expressed support for the new section. At an inaugural dinner, held in London, last Saturday, and at which the president of the Guild, Mr. D. G. Ayles, A.M.I.E.E., the immediate past-president, Mr. S. A. Jelly, A.M.I.PROD.E., and other members from Birmingham were present, an *ad hoc* committee for the London section was formed with Mr. T. O. Young (hon. secretary), Mr. C. E. Hollis, Mr. W. F. Ratcliffe and Mr. R. L. Stevenson. Other associates interested in joining the section should write to the hon. secretary at 32, Bramham Gardens, Earls Court, London, S.W.5. It is hoped to arrange a further meeting of the section at an early date.

Effect of Vibrations during Solidification on the Mechanical Properties of Castings of Gas-turbine Materials

By Jerzy Jagaciak, D.C.Ae., and Josiah W. Jones, M.Sc., F.I.M., A.F.R.Ae.S.

[ABRIDGED]

The present account follows up the earlier work, on the same general subject, at the College of Aeronautics, Cranfield, reported last year in the JOURNAL. *Again, overall amelioration of properties is claimed as a result of the vibration techniques developed and these are explained in terms of the physical changes brought about. An indication is given that the research has progressed to the point where it can be taken over for practical trials in foundries and possible directions which future work might follow are outlined.*

Introduction

The production of turbine blades for modern aircraft is a lengthy and complicated process. The rotor blades, for example, are forged and then machined to the required contours, both being expensive operations. The object of the investigation outlined in this Report was to develop a new method for producing the turbine blades which would save time, reduce the cost and give improved mechanical properties. The proposed method was to cast suitable test castings, and overcome the non-uniformity of the cast structure by vibrating the casting during the solidification period. It was anticipated that the choice of a suitable casting technique would reduce the machining to a minimum, and that the method of vibrating would give the blades the desired strength.

Hinchliff and Jones[1] carried out some work on test wedge-type castings of H. R. Crown Max, vibrating them, while solidification was taking place, at sub-sonic frequencies of 23 and 48 v.p.s. They showed that while mechanical properties were dependent on casting temperatures in the non-vibrated condition, there was some improvement as a result of the vibration at all frequencies. There were critical conditions of frequency and amplitude for the maximum effect but frequency was by far the most important factor. They reported an absence of literature on the phenomena but a later survey is now concluded. From the work on H. R. Crown Max, with new equipment which made possible greater control of conditions, the conclusions of Hinchliff and Jones are confirmed. The work is extended to include Nimonic C75 at sub-sonic and sonic frequencies.

H. R. Crown Max

The composition of this alloy is C, 0.20; Si, 1.60; Mn, 0.40; Cr, 23.00; Ni, 11.50 and W, 3.00 per cent.

Properties. This steel possesses good strength at elevated temperatures, has specific gravity of 8.0, and in the heat-treated condition a yield stress of 30 tons per sq. in. It is usually produced in bar form. Both welding and casting properties are good, and the best casting temperature is about 1,550 deg. C.

Nimonic C. 75

The composition of this alloy is: C, 0.08 to 0.15; Si, 0.30 to 0.80; Mn, 1.00 (max.); Fe, 2.00 (max.); S, 0.015 (max.); Cu, 0.50 (max.); Cr, 19 to 21; Al, 0.40 (max.); Ti, 0.25 per cent.; Ni, balance.

* Reproduced with permission from Report No. 91 of the College of Aeronautics, Cranfield. The full title is "The Effect of Vibrations during the Period of Solidification on the Mechanical Properties of Castings of Gas Turbine Materials."

J. W. JONES

MR. JOSIAH W. JONES joined the College of Aeronautics at its foundation in 1946, as senior lecturer and head of the materials and metallurgy section. He was educated at Bishop Veseys Grammar School, Sutton Coldfield and at the University of Birmingham. In 1921, he received a B.Sc. first class and later an M.Sc. for research on the formation of twin crystals. He was lecturer at the County Technical College, Wednesbury, until 1930, when he joined the Department of Metallurgy at the Birmingham University, where he was particularly associated with metallurgical technology and metallurgy for engineers. From 1938 to 1945 he was honorary treasurer and honorary secretary to the Birmingham local section of the Institute of Metals.

MR. J. JAGACIAK studied at Huddersfield Technical College following which he spent two years at the College of Aeronautics. For his diploma he worked under Mr. J. W. Jones on research on the effect of low-frequency vibration on the mechanical properties of castings. After obtaining his diploma of the College of Aeronautics Mr Jagaciak was accepted as a research student at Massachusetts Institute of Technology, after which he enrolled at the University of Florida, obtaining his M.Sc. in 1955. He is now studying for his Doctorate.

J. JAGACIAK

Effect of Vibration during Solidification

Properties. Tensile strength 46 tons per sq. in. (rolled or cast condition), 0.1 proof stress—30 tons per sq. in., 20 to 30 per cent. elongation, and 20 to 30 per cent. reduction of area. Nimonic C. 75 tends to lose titanium due to oxidation during melting and the operation requires experienced control.

PART I. EFFECT OF SUB-SONIC VIBRATIONS DURING SOLIDIFICATION ON THE MECHANICAL PROPERTIES OF H.R. CROWN MAX

Foundry Equipment and Technique

Since it was desired to develop a technique which would be available in normal foundry practice, such methods were used as far as possible, but the actual equipment was improvized. It was necessary to design and construct an electric-arc furnace of the required small capacity and the vibrating table had to be strong and dimensionally suitable for frame-

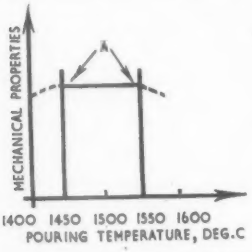


FIG. 1.—*Effect of casting temperature on the mechanical properties of H.R. Crown Max (diagrammatic). A, shows a range of 100 deg. C. where there is no change in mechanical properties.*

work already built. The other main requirements were large range of frequencies and amplitudes, together with considerable load-carrying capacity. The ease, simplicity and speed of operation had to be considered. Such requirements were partly satisfied by the choice of a mechanical vibrator operated by an out of balance cam.

Vibrating Table

The vibrating table of German design was installed. The vibrator operated directly from the mains, and worked on the principle of an offset weight rotating on a shaft driven by a small electric motor. The table was capable of vibrating up to 10 lb. weight at 8,000 vibrations per minute and amplitude 0.4 mm. The frequency was varied by means of a variable resistor for fine adjustment and by altering the position of the leaves supporting the vibrating table for coarse adjustment.

The apparatus was calibrated by the makers, but for the purpose of this investigation, frequency was measured for each casting, at first using a Stroboscope and later a tachometer. The amplitude was measured using a microscope fitted with a mirror at 45 deg. and a scale calibrated in 1/10 mm. The microscope was located with a mirror facing a 1-in. by ½-in. dark plate with a white, thin line and mounted on a side of the vibrating table. During the test runs, the source of light was projected on a plate, and a white line appeared in a microscope as a measurable band.

Melting Furnace

A carbon arc furnace was used for the melting of H. R. Crown Max. The current of 120 to 140 amps. and 80 volts was supplied by a transformer and passed through ½-in. dia. carbon rods. The capacity of the furnace was 3 lb. and the time of heating to the required melting temperature varied between three and four hours. Besides the slow rate of heating, a disadvantage of this furnace was

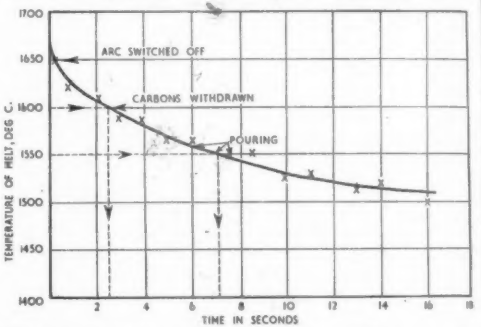


FIG. 2.—*Graph of the rate of cooling of the furnace used to estimate the temperature of pouring.*

an open spout, which, in spite of all the efforts of preheating it by blow-lamps, never reached a temperature higher than 300 to 400 deg. C. Thus, on pouring, the spout was chilling the metal and this was a reason why the quality of some castings was not satisfactory.

Measurement of Temperature

It had been established by previous experiments that H. R. Crown Max has a wide range of temperatures where the properties of castings are not

TABLE I.—*Data Obtained from the First Ten Preliminary Castings.*

Casting Test No.	Frequency, v.p.m.	Amplitude, mm.	U.T.S., tons per sq. in.	0.1 per cent. proof stress, tons per sq. in.	Hounsfield impact value, ft./lb.	Percentage elongation.	Per cent. reduction of area.	V.P. hardness No. at 30 kg. load.
1	0	0	40	22	9.0	30	25	216
2	2,500	1.0	44	23	9.5	30	35	214
3	3,000	3.0	44.8	23.3	—	—	—	215
4	4,000	3.5	—	—	—	—	35	213
5	4,500	2.0	45.4	24	—	38	—	—
6	5,000	1.0	45	23.4	13.3	36	35	211
7	5.500	0.9	—	23.3	13.7	34	35	214
8	6,000	0.6	44	23	10.5	31	30	218
9	6,500	0.3	42	—	8.0	30	30	214
10	7,000	0.15	42	22.5	9.5	30	32	216

affected by pouring temperature (Fig. 1). For this purpose a platinum and Pt/13 per cent. Rh. thermocouple was used to keep the casting temperature within this range. Later, the cooling rate of the furnace was also found (Fig. 2).

During the casting process, the temperature of the furnace was raised to 1,650 deg. C., the arc then switched off, the temperature checked and when it reached 1,600 deg. C. the carbons were withdrawn and the melt poured into an already vibrating shell. This operation, from the withdrawal of the carbons to pouring, took five to six seconds. Therefore, the temperature in the furnace, on pouring, must always have been within the permissible range (Fig. 2).

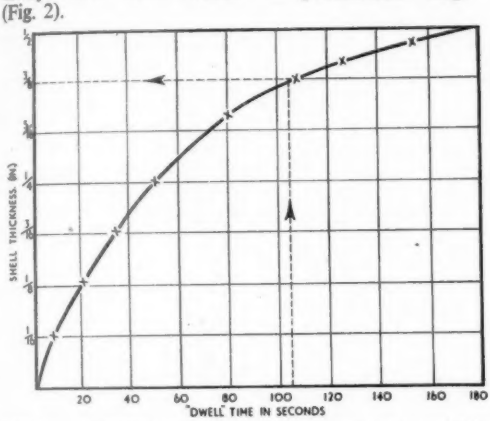


FIG. 3.—*Control of the thickness of the shell mould.*

Shell-moulding Technique

There are a few available types of moulds that could be used for this work, but the latest shell-moulding technique seemed to be most suitable. For example, Sillimanite base moulds were used in previous work, but because of their heaviness, expense, and the difficult method of production, they were not considered to be ideal for the purpose of this investigation. The smoothness of castings and the precision of shell moulding indicates that the method may be considered for casting of turbine blades. Tolerances on castings can be reduced to as little as 0.002 to 0.005 in. The method is also suitable for mechanization.

A brief summary of the procedure for producing shell mouldings is as follows:—

(*a*) Thorough mixing of sand and resin in the following proportions*: 80 parts of sand H (Redhill), 20 parts of sand F (Redhill), 0.05 parts of Bakelite wetting reagent (Z.11502), 7 parts of Bakelite resin (RO222).

(*b*) Heating of pattern at 250 deg. C. for two minutes and application of Bakelite parting agent (Z.11501).

(*c*) Pattern allowed to remain in contact with mix for about 100 seconds, in order to form about ¼ in. thick semi-molten layer (Fig. 3).

(*d*) Curing of pattern and adhering crust in an oven at 350 deg. C. for about three minutes. At this stage, it is best to judge visually the quality of the shell, a brownish colour indicating the completion of this process. Overbaking or burning results in a weak pattern.

(*e*) Ejection by gentle tapping.

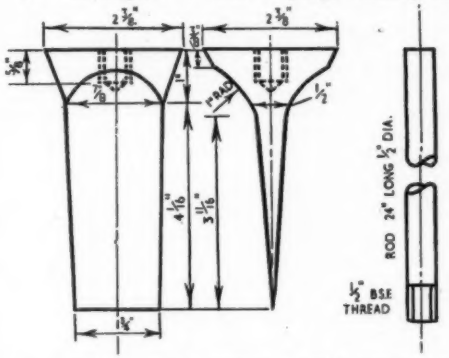


FIG. 4.—*Design of the pattern for the test casting. The rod is screwed in at the top of the pattern.*

Choice of Pattern

The object of this investigation was to cast an average shape of turbine blade in present-day use, and a mild-steel pattern was made to comply with the specification used by Hinchliff and Jones[1], *i.e.* a simple wedge-type shape without curvature (Fig. 4).

Fixtures and Clamps for Vibrating the Mould

In order to hold the mould in position while

* Pre-mixed sand and resin can now be purchased.

TABLE II.—*Table Giving V.P. Hardness Numbers for the First Ten Preliminary Castings.*

Testing position.	1	2	3	4	5	6	7	8	9	10
Casting No. and frequency.	0[a]	2,500	3,000	4,000	4,500	5,000	5,500	6,000	6,500	7,000
1	235	225	223	—	—	236	231	233	224	227
2	222	221	220	—	—	206	219	220	219	214
3	220	212	—	—	—	207	207	220	216	213
4	211	205	210	—	—	210	207	210	208	213
5	209	211	213	—	—	201	207	215	211	208
6	201	213	210	—	—	204	—	214	200	—
7	—	—	—	—	—	—	—	—	208	—
Average values ..	216	214	215	—	—	211	214	218	214	216

Values given in this Table are already average values obtained from three readings across the section of the casting. To get all the "averages" 210 V.P. hardness numbers were taken.

Effect of Vibration during Solidification

vibrating, it was necessary to design special fixtures and clamps. The clamps had to be easy to operate and able to withstand "burning" by split metal. To test the rigidity of the clamps, the vibrations of the table were compared with a number of vibrations of shell mould and casting by means of a Stroboscope. It was found that there were no differences in vibrations per min., the clamps were therefore considered satisfactory.

Foundry Practice

Casting of H. R. Crown Max

One of the most important facts established from previous work is that the frequency (not the amplitude) has the greater effect on the mechanical properties of castings. The investigators believed that there may be some critical values of frequencies and amplitudes resulting in maximum improvement in mechanical properties of castings. Therefore, it was first necessary to find the range of frequencies and amplitudes showing maximum improvement in mechanical properties. For this, ten preliminary castings were made, with frequency and amplitude being varied simultaneously. By cutting specimens from these castings, and testing them for properties, the effect of frequency and amplitude was determined. The results of mechanical tests are set out in Tables I and II. Hence, by this procedure, it was possible to fix the amplitude at the point of maximum improvement and vary the frequency independently and *vice versa*.

Method of Testing the Castings for Properties

Vickers Pyramid Hardness Test. The ten preliminary castings were tested for hardness by using a Vickers pyramid hardness machine at 30 kg. load. Readings were taken every half-inch along the length of the section of casting (Fig. 5). Table II shows the data obtained. From this the average Vickers pyramid hardness number was found for each casting. It is evident that although there is no marked increase of hardness in the case of vibrated castings, yet the values are more uniform throughout the whole section of blades, thus indicating a more uniform arrangement of crystals.

Macrostructures. The castings were polished and macro-etched, the etching reagent being Aqua Regia. It was found that the reagent was most efficient at about 30 to 35 deg. C. Macro-etchings of the castings showed the change from the columnar structure to the small and uniform equi-axed structure of the vibrated castings. The change was quite clear to visual examination but owing to the surface of the casting photographs were not very satisfactory.

Selection of test-pieces from casting. The "sampling" of the test-pieces from the representative castings was considered carefully, and the best positions specified. It was decided to cut two No. 11 tensile test-pieces, one "vertical" and the other "horizontal," together with one "horizontal" impact test-piece.

Mechanical Tests. The tensile test-pieces were tested on Hounsfield testing machines. The impact specimens were notched and tested using Hounsfield impact testing machines. The values obtained are shown in Table I. It should be pointed out that the fractures of the tensile and impact test-pieces were examined for inclusions and porosity before accepting any data as satisfactory. There were no false fractures due to the machining of the test-pieces.

FIG. 5.—*Distribution of hardness tests.*

Conclusions from tests of ten trial castings. The data obtained from the first ten preliminary castings revealed the general effect of vibrations on

TABLE III.—*Data Obtained when Investigating the Effect of Frequency, Amplitude being Constant at* 2 mm.

Casting Test No.	Frequency, v.p.m.	U.T.S., tons per sq. in.	Hounsfield impact value, ft./lb.	Percentage elongation.	Percentage reduction of area.	0.1 per cent. proof stress.	Density.
1	0	39.5	7.4	29	24.5	22.5	8.062
2	2,000	43.0	—	36	26.0	23.3	—
3	3,000	44.0	10.0	36	33.0	24	8.170
4	3,500	—	10.0	—	—	—	—
5	4,000	45.0	—	39	34.5	25	—
6	4,500	44.6	12.0	38	33.5	24.3	8.207
7	5,000	45.0	—	—	—	24.7	8.183
8	6,000	44.8	11.2	31	30.0	24	8.130

TABLE IV.—*Data Obtained when Investigating the Effect of Amplitude, Frequency being Constant at* 4,000 *v.p.m.*

Casting Test No.	Amplitude, mm.	U.T.S., tons per sq. in.	0.1 per cent. proof stress, tons per sq. in.	Hounsfield impact value, ft./lb.	Percentage elongation.	Percentage of reduction area
1	0	39.7	22.2	8.5	30	25
2	0.70	45.5	25	13.2	40	36
3	1.0	46.0	25	12.5	36	35
4	1.5	45.0	24.8	—	37.5	31
5	2.0	45.0	24	12.7	35	32
6	2.5	44.4	23.3	11.5	35	—
7	3.0	43.5	22.8	9.5	—	31
8	4.0	—	—	—	—	—

mechanical properties of castings and the following conclusions can be drawn from Figs. 6 and 7. (*a*) the sub-sonic vibrations cause an improvement in mechanical properties of castings and (*b*) the most beneficial frequency is about 4,000 v.p.m. and amplitude of about 2 mm.

Effect of Frequency on Cast H.R. Crown Max, Amplitude being Fixed at 2 m.m.

Method of Casting

It was now decided to fix an amplitude at 2 mm., *i.e.* the point of maximum improvement in mechanical properties, and vary the frequency throughout the available range. As it was not possible to vary the frequency without altering the amplitude on the existing vibrator, a special cantilever was designed by means of which it was possible to load the table mechanically, suppressing the amplitude without altering the number of vibrations of the table.

The casting technique during this stage was exactly the same as in the case of the ten preliminary castings described later in Part II. To cover the whole range of frequencies, fifteen castings were made.

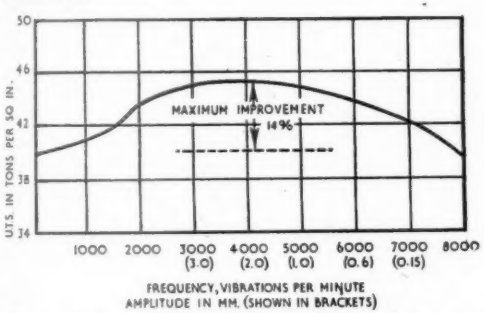
density. For this purpose, special equipment was used, and the data is shown in Table III. The apparatus consisted of a precision balance and a vacuum flask. The specimens were degreased, dried and weighed in air. The Archimedes principle was used in the determination of values of densities, and it was therefore necessary to weight the test-pieces again in water at 4 deg. C. This low temperature was maintained by adding small particles of ice to the contents of the flask.

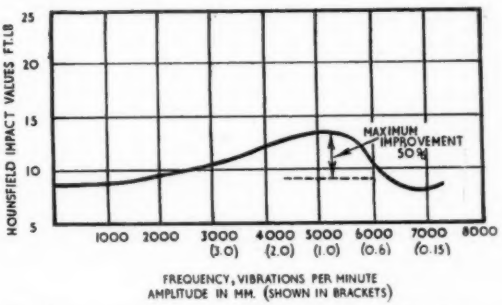
Presentation of Results

The results obtained in Part I are presented in Tables III and IV and summarized in Table V.

TABLE V.—*Effect on Mechanical Properties of Variation of Frequency from 2,000 to 6,000 v.p.m.*

	Non-vibrated.	5,000 v.p.m.	4,000 v.p.m.
Tensile strength, tons per sq. in.	40	45.5	45.4
0.1 per cent. proof stress, tons per sq. in.	22	23	24
Elongation, per cent. on 2 in.	30	36	38
Balanced impact, ft./lb. ..	9	13.3	—





FIGS. 6 *and* 7.—*Physical properties of the test castings according to frequency of vibration.* FIG. 6.—*Ultimate tensile stress, and* FIG. 7.—*impact properties.*

Testing Specific Gravity of Castings to Explore Changes in Porosity

In order to explore the effect of vibrations on castings as the means of improving the mechanical properties, it was decided to test the castings for

The impact test was not available from the castings at 4,000 v.p.m. but there would appear to be little difference between the effect of these frequencies. It should be noted that strength, elongation and impact share in the improvement.

TABLE VI.—*Data Obtained when Casting Nimonic C.75.*

Casting Test No.	Frequency v.p.s.	Amplitude, mm.	U.T.S., tons per sq. in.	Hounsfield impact values, ft./lb.	Percentage elongation.	Percentage reduction of area.	0.1 per cent. proof stress, tons per sq. in.	Density.
1	0	0	45	16	24	27	30	8.301
2	50	0.765	46	16.5	27	32	32	—
3	70 and 80	0.36	50	25	31	35	34	8.354
4	100	0.22	50	28	29	31	34	—
5	150	0.16	47	26.5	26	28	31	8.318
6	200	0.10	—	—	—	—	—	—
7	500	0.11	45	16.5	26	28	30.5	—
8	800	0.12	46	15.0	26	26.5	29	—
9	1,000	0.11	—	—	—	—	—	—
10	2,000	0.13	—	16.0	24	—	—	8.305
11	3,000	0.12	45.5	16.5	24	27	31	—
12	4,000	0.10	47.5	14.0	25	28.5	31	8.295
13	5,000	0.11	—	—	—	—	—	—
14	6,000	0.15	46.5	16.5	25	28.5	30	—
15	8,000	0.10	46.6	17.5	26	29.5	30.5	8.31
16	10,000	0.09	48	19.0	27	30.3	32	—

Effect of Vibration during Solidification

Effect of Varying Amplitude with Fixed Frequencies of 4,000 v.p.m.

To find the influence of variation of amplitude on the mechanical properties of castings, it was necessary to fix the frequency at 4,000 v.p.m. and vary the amplitude. The cantilever described previously was used to control the right amplitudes. Ten castings were made covering the whole range of amplitudes. The castings were cut and tested in the usual manner. The data are given in Table IV. There is a maximum value of amplitude to give the best improvement for both elastic and plastic properties. From the graphs it could be deduced as:—

Property.	Maximum value of amplitude.
Tensile strength	1 to 1.5 mm.
Proof stress	0.75 to 1.25
Elongation, per cent.	0.5 to 1.0
Reduction in area, per cent.	0.5 to 1.0
Impact, ft/.lb.	0.75 to 1.25

A common value would be about 1.0 mm. but it suggests that the plastic properties respond more quickly to the effect of the vibration.

Examination of Microstructures

The microstructure confirms the mechanical testing as the characteristic large dendrite in the static casting has completely disappeared under the influence of vibrating at 4,500 v.p.m.

It is difficult to decide if this refining effect continues at 6,000 v.p.m. at this magnification but at × 600 the increased resolution suggests that the areas of primary deposits and the coring effect is less as a result of vibration. The effect is similar to a slight annealing of cast structure and it may be that the vibration and mixing effect promote diffusion and so bring the structure nearer to equilibrium. It is difficult to say that the grain size of the matrix is smaller but the larger number of primary deposits suggest this effect and in fact would promote it.

The examination of the "as polished" condition suggests that vibration distributes inclusions finely and more uniformly, and the determination of density has suggested that porosity is reduced. Present theories of the influence of microstructure on mechanical properties would confirm that the changes in microstructure between the static and vibrated casting would be associated with the improvements in elastic and plastic properties which have been found.

Conclusions

From the experimental data it is concluded:

(*a*) That for H. R. Crown Max there is a simultaneous increase in the value of all tensile properties in the vibrated compared with the non-vibrated castings. (See table in adjoining column.)

The improvement in elastic and plastic properties suggest homogenization of the structure and an approach to its maximum possible properties.

(*b*) Microscopic and macroscopic examination reveal a refining of the structure, and a substitution of the traditional structure of

	Non-vibrated.	4,000 v.p.m.
Tensile strength, tons per sq. in.	39.6	45
0.1 per cent. proof stress, tons per sq. in.	22.5	25.0
Elongation, per cent. on 2 in.	29	39
Reduction in area	28.5	34.5
Impact, ft./lb. Hounsfield	7.4	10.0

elongated crystal grains for a uniform equiaxed structure which confirm the improved mechanical properties recorded above.

(*c*) The improved impact value meets a major need for castings.

(*d*) The results are further confirmed by the increase in density which is quite definite as the effect of increased frequency reaches a maximum, but further work to measure density at higher frequencies would be of theoretical value.

PART II. EFFECT OF VIBRATIONS, SUBSONIC AND SONIC, DURING SOLIDIFICATION ON THE MECHANICAL PROPERTIES OF NIMONIC C.75

Introduction

It has been proved from the experiments conducted on H.R. Crown Max that the effect of frequency on the mechanical properties of castings is beneficial up to 67 to 83 v.p.s., and that beyond this point the effect gradually diminishes, it was, therefore, of great interest to find the effect of frequency higher than 116 v.p.s.

Due to the type of vibrator used, it was not possible to increase the frequency above this value during the investigations on H. R. Crown Max so effort was directed to developing suitable apparatus that would enable this experiment to be performed. The expectations from such experiments were also increased by the report written by Russian workers[2] investigating a similar problem. Their approach was somewhat different, as they were introducing the changes in structure of steels by using high-frequency currents. One of their most relevant conclusions was that the properties of steels during these experiments were rising to a certain maximum, falling to normal again and rising infinitely afterwards. Impressed by this evidence, it was decided to investigate the effect of higher frequencies on mechanical properties of Nimonic C. 75 and this part of the Report describes the development of suitable apparatus, the method of casting and the results obtained. The range of frequencies was between 0 and 10,000 v.p.s. (Note change of units to vibrations per second for Nimonic C. 75 only.)

Description of Apparatus

Electromagnetic Vibrator

An electric vibrator built at the College was used. The apparatus consists of a power unit, an amplifier and an exciter. The associated units will vibrate mechanical structures linearly within

the frequency range 0 to 10,000 v.p.s., and maximum thrust of 2 lb. and maximum amplitude of 1 in. with a power requirement of 120 watts. The frequencies at which the castings were made were read from the oscillator dial. The dial was carefully calibrated during the building period of the vibrator against a cathode tube.

The amplitudes were measured by using a travelling microscope calibrated in 1/100th mm. and focused on Perspex mounted to the exciter rod. The Perspex was coated with tinfoil except for a very thin horizontal line cut with a razor blade to permit the light to pass from behind. This process of measuring the amplitudes was rather complicated, requiring great accuracy and concentration. The method was still further complicated when it was found, during the test runs, that the wave pattern of the vibrating system was non-linear.

In spite of all the efforts to eliminate a superimposed frequency by means of cushioning the vibrator, the ideal conditions were never reached, as these oscillations are contributed by the vibrations of the building foundations. It was necessary to make about twenty castings to cover the whole range of available frequencies. It was thought advisable to specify these and carry out the experiments in accordance with this schedule.

Realizing the difficulties met while measuring the amplitudes, it was decided to obtain them at the specified frequencies prior to the casting process. It was necessary to simulate the conditions met during the test runs. For this purpose, a static casting was made, placed back in a shell mould and fixed in a position "ready for pouring." At the selected frequencies, the amplitudes were measured and tabulated (Table VI).

Development of New Furnace

For this set of experiments, a new furnace had to be designed and built. Although similar in shape to that used in the first part of the Report it had many modifications and improvements.

(*a*) Suitable air gaps were introduced between crucible and furnace wall.

(*b*) The top of the furnace was reinforced with mild-steel bars.

(*c*) An electrically preheated spout was introduced as a means of improving the quality of castings. It consisted of an electric element wrapped round a heat-resisting tube. The current of 4.5 amps. was passed from the mains through a variac and transformer. The spout temperature just before the pouring was about 800 to 900 deg. C.

(*d*) The material used for the building of the furnace lining was crushed sillimanite and sillimanite silester mixture.

The capacity of the melting pot, as before, was about 3 lb. The time required to raise the furnace to the desired temperature varied from 1 to 1½ hours.

Measurement of Temperature

The best casting temperature of Nimonic C. 75 is about 1,530 deg. C. During the casting process, the temperature of melt was raised to about 1,620 deg. C., arc switched off, temperature measured and the metal poured into the already vibrating shell. Fig. 8 gives the rate of cooling of the furnace and the operating sequence. It can easily be assessed that the casting temperature was always within the permissible range.

Choice of Pattern for Casting

It was decided to cast a rod ¼-in. dia. and about 6-in. long. Fig. 9 gives a detailed sketch, and the position of the test-pieces. Two preliminary castings were made to see whether, due to excessive length of rod, the casting would not be porous at the bottom. It was found that the castings were perfectly sound and it was decided to use this pattern, except for the very local pipe at top of feeder head.

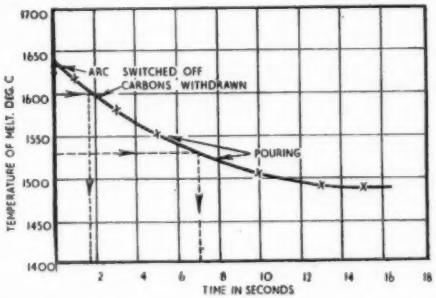


FIG. 8.—*Rate of cooling of the furnace to control the temperature of operation.*

Elastic Suspensions and Fixtures for Shell Mould

An exciter was capable of vibrating safely two pounds through the required range of frequencies. The weight of shell and casting was nearly this amount. It was considered necessary then to suspend a shell in a "neutral position" so that the load on the exciter would be reduced practically to nothing. For this purpose, a special clamp was designed to which a shell could be easily fastened and a special frame built to facilitate this suspension. As described before, the exciter rod was tapped 5BA, and in order to fasten the shell permanently to the rod, the shell was made with a screw at the bottom (Fig. 10).

Foundry Practice

Method of Casting

It was decided to make about 20 castings covering the whole range of frequencies and amplitudes. The method of casting, although similar in procedure to that described when dealing with H. R. Crown Max, involved the addition of two per cent. NiTi or FeTi since at high temperatures titanium tends to oxidize. The compositions of those are as follow:—FeTi 30 per cent. Ti (10 per cent. Al, balance Fe) and NiTi 20 per cent. Ti (10 per cent. Al, balance Ni).

Effect of Vibration During Solidification

In the case of the casts described in this section, FeTi was added on the completion of the melting process. Obviously, this meant that the bars ready for melting had to be weighed very carefully. Also, just before pouring into the shell, a deoxidizing reagent, magnesium, was added in the following proportion and composition:—0.05 per cent. magnesium—as 5 per cent. MgNi alloy.

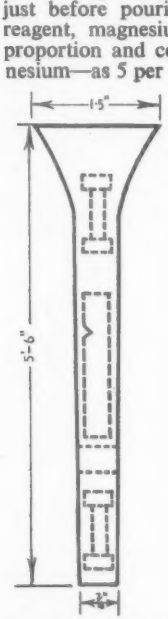


FIG. 9.—*Position of the test-pieces in casting.*

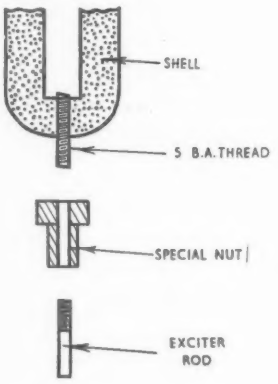


FIG. 10.—*Attachment of the mould bottom to the vibrator.*

The sequence of operations when casting, can be summarized as follows:—

(*a*) Furnace raised to the required temperature.

(*b*) Bar weighed and fed into furnace.

(*c*) When at the required temperature, checked by optical pyrometer, additions of Fe Ti, and about half-a-minute later Mg were made.

(*d*) Vibrator for mould switched on and set at the required frequency.

(*e*) Arc switched off and temperature checked by means of platinum + 13 per cent. Rhodium thermocouple.

(*f*) When at about 1,600 deg. C. carbons withdrawn and the melt poured into the already vibrating shell.

This last process took from 5 to 6 secs., therefore it can be concluded that the pouring temperature must always have been at about 1,530 deg. C.

Conditions of Vibration

Owing to the limitations of power there is a tendency for amplitude to vary and decrease with increase of frequency. Above 100 v.p.s. however, the variation was only between 0.2 and 0.1 mm. and so frequency was considered the only variant above 100 v.p.s.

The major improvement in properties for this material was however found in the fequency range below 100 v.p.s. and there was a large variation in amplitude. Experience with H. R. Crown Max showed that the effect of amplitude was a minor one but it will be necessary to explore this effect for this alloy with other apparatus when available.

Also, unlike H. R. Crown Max, which showed a maximum improvement and a critical frequency, the improved mechanical properties increased due to vibration to a maximum at 80 v.p.s., decreased to a low value at 1,000 v.p.s. and then gradually increased to a new maximum from 5,000 to 10,000 v.p.s. which was the limiting conditions of the work. These effects are summarized in Table VI.

Method of Testing

The test-pieces were cut as specified in Fig. 9 and tested for mechanical properties using a Hounsfield Tensometer test specimen No. 11 and a Hounsfield balanced impact test. The test data are tabulated in Table VI.

Effect of Casting Technique on Microstructure

It was found that the best etching reagent consisted of 16 parts of saturated ferric chloride, 1 part of sulphuric acid, 3 parts of hydrochloric acid, 16 parts of water and the best etching time was about 30 sec. Similar effects were found in the microstructure as with H. R. Crown Max. The typical cored dendrites of the cast structure are changed to the equivalent of an annealed condition with suggestions of a small grain size and uniform distribution of fine constituents.

The surface in the "as polished" condition shows the reduction in porosity which is confirmed by the determination of specific gravity. The fact that the maximum mechanical properties coincide with maximum density is of considerable theoretical interest and justifies further experiment.

Conclusions from Experiments with Nimonic C.75

The material showed improved mechanical properties as a result of the vibration. Unlike the H. R. Crown Max, it not only showed a critical effect at sub-sonic frequency 80 v.p.s. but after falling to a low value similar to the non-vibrated condition at 800 v.p.s. continued to rise again to the limiting conditions of the vibrator 10,000 v.p.s.

The following values are extracted from the full data in Table VI.

	Non-vibrated.	80 v.p.s.	10,000 v.p.s.
Tensile strength, tons per sq. in.	45	50	48
0.1 per cent. proof stress, tons per sq. in.	30	34	32
Elongation, per cent. on 2 in.	24	31	27
Balanced impact, ft./lb. ..	16	25	19

This alloy confirms a most attractive feature of this method, in that not only are the ultimate and

proof strength improved but so also are the elongation and impact values.

The valve operated electromagnetic vibrator is an expensive piece of equipment both in cost and maintenance, especially if provided with enough power to overcome the limitations experienced in this work, and to control both frequency and amplitude for a casting of practical size. Further it is not of a suitable robust character for use on a foundry floor. The improvements associated with the lower subsonic frequency, as available from an electro-mechanical device, will justify the practical use of the method.

PART III. SUMMARY

Theoretical Discussion

The theoretical possibilities and mechanism of vibration on the cast structure are discussed by Hinchliff and Jones[1]. It is suggested that high mechanical properties of a material, in particular a combination of strength, elongation and impact value, are associated with the microstructure found in forgings but the reverse of these conditions is always found with the structure formed by the ordinary mechanism of cooling associated with castings.

The vibration, by introducing mixing effects, should reduce the gradient of temperature which produces the long narrow dendrite of the cast structure and by promoting more uniform conditions of temperature and chemical composition produce a more uniform equiaxed crystal grain structure analogous to that found in a forging. It is also suggested that these conditions would remove, by more uniform distribution, the weakening defects always found in the condition of the grain boundary of cast structures.

It is of considerable support to these theoretical suggestions that two quite different alloys respond in the same fundamental way to changes in microstructure and the associated improvements in all mechanical properties. It is anticipated that similar improvement will take place in fatigue strength.

General Conclusions

From the experiments conducted on H. R. Crown Max and Nimonic C.75 the following conclusions can be drawn:—

(1) There is a marked improvement in mechanical properties of castings due to effect of vibrations in sub-sonic range. The maximum improvements occur at about 4,000 to 5,000 v.p.m. for H. R. Crown Max and about 75 to 85 v.p.s. for Nimonic C.75. These are tabulated below.

	Percentage improvement in H.R. Crown Max.	Percentage improvement in Nimonic C 75.
Ultimate tensile strength ..	14	11
Impact	62	61
Percentage elongation	30	25
Percentage reduction of area ..	40	28
0.1 per cent. proof stress ..	10	13

(2) The improvements in mechanical properties were confirmed by the changes in microstructure which were common to both materials. Large cored dendrites disappeared and in place of them there was a finer structure approaching an annealed condition. There was an increase in density associated with the highest test results.

(3) It is to be expected that general casting properties would improve in the vibrating mould and it is of interest to note there was no cold shut with the H. R. Crown Max even in the thin end of the mould representing the trailing edge of a blade, in spite of the fact that the shell mould was cold. It is probable that castings which are "just failures" under present practice may be possible by this method.

(4) The electro mechanical vibrator is not an expensive piece of equipment and is robust enough for use on a foundry floor.

(5) Further work will be necessary to investigate whether parts of a casting of varying thickness would share equally in the refining effect but with the H. R. Crown Max the casting decreased from ½ in. thickness to a very thin section while the Nimonic alloy was of uniform section.

(6) Both alloys show the attractive effect that both strength and plastic properties are improved, as also is the impact value which is often the particular limiting factor in the use of castings. From these effects there is good hope that even fatigue properties may be increased.

Acknowledgments

The Authors are grateful to Professor J. V. Connolly, B.S., F.R.Ae.S., for originally suggesting the work and continued interest.

[1] Hinchliff and Jones. "Effect of Sub-sonic Vibrations during the Period of Solidification of Castings." College of Aeronautics Report No. 89. (FOUNDRY TRADE JOURNAL, September 1, 1955, p.251)

[2] Sokoloff, S. Va. "Influence of Ultrasonic Waves on the Solidification of Molten Metal." *Acta Physicochemica*, U.S.S.R., 3 (1935), p. 939.

[3] Crawford, A. E. "Some Metallurgical Applications of Ultrasonics." *Metallurgia*, 47, No. 281, 1953.

Rhodesian Contracts for Britain

Acrow (Engineers), Limited, has been awarded the contract for all the steel formwork for the Kariba Gorge hydro-electric scheme, Southern Rhodesia. The order was placed by the Italian group, Impresit Kariba (Pvt.), Limited, the main contractors for the project. The first part amounts to more than £100,000. The Italians appeared to be keen to place the maximum amount of orders in Britain provided right delivery and prices could be maintained, said Mr. W. A. de Vigier, chairman of Acrow (Engineers).

The Federal Power Board has also announced that British Insulated Callender's Cables, Limited, has been awarded a contract worth £200,000 for the Kariba scheme. The contract is for the manufacture, supply, testing, completion, and commissioning of 330 kv., 11 kv., and auxiliary cables connecting main transformers in the underground power station to the switchyard.

THOS. W. WARD, LIMITED—Mr. C. Parry (with 40 years' service), Mr. H. H. Mumby (37 years), and Mr. W. Hall (29 years), all of whom have been directors since 1948, have joined the board.

British Standards Institution

New Standards for Grey-iron Castings (*B.S.* 1452 : 1956) *and Iron Castings with Spheroidal or Nodular Graphite* (*B.S.* 2789 : 1956)

As intimated in recent issues of this JOURNAL, two new British Standards for cast iron have just been published, as follow:—

B.S. 1452. The new edition of this standard incorporates the result of experience with the 1948 edition, the principal alterations being: (*a*) The tensile test has been made the basis of the specification, but for the control and regularity of product the transverse test may be substituted for the tensile test to a specified extent; (*b*) the introduction of a test sample for large and/or heavy castings is an alternative to the use of very large test-bars; (*c*) the deflection requirement in the transverse test has been amended, this figure now being required only for the higher grades as an indication that the material has some improved impact resistance as compared with the lower grades, and (*d*) to facilitate machining, there is an amendment of the radius of the end of the parallel length of the tensile test-pieces. A feature of the revision is an appendix which shows, in the form of a graph, the strength that might be expected in different ruling thicknesses of the same casting.

B.S. 2789 (*Iron Castings with Spheroidal or Nodular Graphite*). This is a new standard to cover a type of iron with properties fundamentally different from those of normal grey iron with flake graphite. In particular the new iron possesses greater tensile strength and may acquire a considerable degree of ductility together with a resistance to impact many times greater than that of ordinary grey iron. The standard includes requirements not only for tensile strength, but also for elongation, hardness, permanent-set stress and, in certain cases, resistance to impact. It covers the bulk of the commercial applications and caters for three types of iron:—Type 1—having a mainly pearlitic matrix characterized by high tensile strength, but in which ductility and resistance to impact are of less importance; type 2A—having a mainly ferritic matrix of moderately high tensile strength in which high ductility and toughness are of great importance, and type 2B—having a ferritic matrix in which resistance to impact is of paramount importance. Materials falling between the mainly pearlitic and mainly ferritic grades may be obtained by adjustment of the composition or by appropriate heat-treatment. Further, the iron may also be alloyed to produce acicular, martensitic and austenitic irons. However, the major interest has been in the classes quoted, and the British Standard is at present confined to those classes for which there is a firm basis of experimental and production data.

Copies of these Standards are available from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. (B.S. 1452 price 4s. and B.S. 2789, 3s. 6d.).

Correction: The Authors of the article "Surface Defects in Some Sand-cast Stainless Steels," published in the JOURNAL, August 2, 1956, have pointed out a correction to Fig. 1 with the following effect. "Fig. 1—Casting (*a*) was untreated, while casting (*b*), treated with aluminium paint, shows better definition and considerable reduction in cold shuts and 'measles.' (Reproduction approximately ¼ full size)." In the supplementary data for this illustration, the carbon content was incorrectly quoted as 0.119 instead of 0.109 per cent.

New Medical Centre

A new medical centre of the Stanton Ironworks Company, Limited, near Nottingham, opened by Sir George Barnett, Chief Inspector of Factories, on November 14, has been designed to take into account the development and improvement of hosiptal facilities since the advent of the National Health Service in 1948. Nowadays, the more serious injuries are sent at once to hospital in the company's own ambulance, but a staff of State registered nurses and a chartered physiotherapist, equipped with modern apparatus, take care on the premises of the many cases of so-called minor injuries. Members of the Stanton Ironworks division of the St. John Ambulance Brigade take over at week-ends. An X-ray machine has been installed and this is used for chest examinations of all new and existing employees. In addition, photographs are taken of skin conditions for research purposes. By means of lectures, it is also hoped to teach safer working methods and thus prevent some of the injuries which tend to be regarded as inevitable in heavy industry. At its main works, the company employs some 6,200 persons, and each month about 3,000 items of service are given by the medical department, which has been supervised by a whole-time doctor since 1946.

How to Save Fuel Oil

To assist fuel-oil users during the present period of restricted supplies, the Federation of British Industries, in co-operation with the National Industrial Fuel Efficiency Service, has compiled a leaflet entitled "Hints on Saving Fuel Oil," which is available from the FBI headquarters, 21, Tothill Street, London, S.W.1. Every firm which uses fuel oil is advised to appoint a responsible person to keep watch on all activities which influence oil consumption either directly or indirectly. The leaflet also lists 25 economy hints dealing with steam raising, steam utilization, furnaces, space heating and domestic hot-water. Those relating to furnaces are: (1) investigate the degree of loading; rearrange production schedules where possible to ensure loading to maximum capacities; (2) reduce outside surface temperatures by the addition of a layer of insulating bricks or other suitable medium, and (3) investigate whether operating hours can be reduced by later lighting up and earlier shut-down.

UK & ECSC Association Meeting

The Council of Association between the United Kingdom Government and the High Authority of the European Coal and Steel Community held its fourth meeting at Lancaster House, St. James's, London, on November 16. The Rt. Hon. Peter Thorneycroft, M.P., president of the Board of Trade, led the United Kingdom delegation, which included the Rt. Hon. Aubrey Jones, M.P., Minister of Fuel and Power, Sir Archibald Forbes, chairman, the Iron and Steel Board, and Mr. James Bowman, chairman, the National Coal Board. The High Authority of the ECSC was represented by Mr. R. Mayer, president of the High Authority, Mr. F. Etzel, vice-president, and two members Mr. D. Spierenburg and Mr. A. Wehrer.

MONKS & CRANE, LIMITED—Mr. B. C. Kirk and Mr. E. C. Martin, chairman and joint managing director, respectively, have relinquished these offices. Mr. D. W. Thomas has been appointed chairman and Mr. V. G. Eyre managing director.

Joint Iron Council's Report

Ironfounding Affected by Redeployment of the National Resources

[Abridged]

At the annual convention of the Joint Iron Council, held in London on November 6, the executive committee presented its report to June, 1956, from which the following abstracts have been made:—

The year under review has been one of change and economic reassessment. It opened with high rates of increase in production in most sections of British industry and hopes of a rapid increase in the standard of living. It was increasingly realized in the second half of 1955 that serious balance of payments difficulties were developing as a result of the pressure of home demand and that inflationary price and wage movements were becoming pronounced. In an effort to meet this situation, the Government adopted new economic measures. The emergency Budget of the autumn together with the tightening of hire-purchase finance control, were aimed at reducing consumer demand, while the intensification of the credit squeeze sought to reduce the overall effect of investment.

Whether as a result of these policies or not, recent months have seen a marked improvement in the country's overseas balance of trade and payments position, but so far little has been achieved with respect to the basic problem of inflation—that of the upward trend in wages.

During the first half of 1956, it has become apparent that the economic policy of the Government might involve a considerable amount of redeployment of the country's resources. This redeployment, the effects of Government efforts to reduce excess demand and the failure of wages to achieve stability, form the general economic background to JIC year 1955/56.

State of Trade in the Industry

In view of the disturbed conditions which have prevailed in industry during the year, the iron castings production as a whole must be considered satisfactory. Output of iron castings was 3 per cent. higher than in the previous twelve-month period and each quarter's output in the current year has exceeded that of the corresponding quarter in the previous year. Output in the first half of 1956 was 2,062,000 tons, compared with 2,005,000 tons in the first half of 1955 and while it would be unwise to forecast total output in the calendar year 1956, it seems possible that the 1955 record output of 3,925,000 tons may be broken in 1956 and a new record established with an output of approximately 4,000,000 tons.

The fortunes of the different sections of the industry, however, have differed widely and appear to reflect something of the effects of the redeployment of national economic resources referred to above. These effects are not solely confined to the building and automobile sections but appear also in the engineering and jobbing section where the increases in outputs of castings for the heavier capital goods industries (notably the electrical engineering industry) tend to be greater than for the lighter industries. In the case of one section—ingot moulds—the rise is much greater than would normally be expected from the known rate of output of the user industry. It could thus reflect some increase in stocks which may be followed by a reduction in demand and output later in the year.

Automobile Castings

Automobile castings output (including tractors) increased by 5 per cent. compared with the year 1954/55, but this increase was largely the result of the high output of the second half of 1955. In the first half of 1956, output was 3 per cent. below that of the first half of 1955. The second quarter of 1956, in particular, showed a sharp reduction of output. Production of castings for building and domestic use shows a similar but less pronounced movement. Output over the year 1955/56 was little changed from that of 1954/55, but the first half of 1956 showed a reduction of nearly 5 per cent. below that of the first half of 1955. Output of castings for the engineering section was only slightly less buoyant than in the year 1954/55, an increase of 7 per cent. being achieved as against 9 per cent. in that year. The increase in output of pressure pipes at 2 per cent. was almost the same as in 1954/55. Railway castings showed a 3 per cent. increase, much of this being due to the large increase of the second quarter of 1956. Ingot mould output was 14 per cent. higher in 1955/56 than in 1954/55, but this was strongly influenced by the abnormally high output in the first half of 1956. Output in the second quarter of 1956 actually reached a level 25 per cent. above that of the second quarter of 1955. (For production statistics, subdivided according to use, see Table I.)

The changes in the pattern of output which have become noticeable in the first half of the calendar year have had their effects on the pig-iron producing section of the industry. While local shortages and supply difficulties of particular grades cannot be said to have entirely disappeared, a marked easing of supplies has taken place. The serious shortages of hematite and low-phosphorus pig-iron which were so much in evidence in June of last year and which continued as a problem to the industry during the rest of 1955, had become less serious and widespread during the second quarter of 1956. Stocks of high-phosphorus pig-iron were reduced in the first half of 1956 and charges showed some reduction below the corresponding levels of the previous year. Production has been falling over the year 1955/56 and certain furnaces have changed to basic iron production.

Total pig-iron stocks at the end of the period 1955/56 at 304,000 tons compared with 252,000

tons at the end of 1954/55. In the case of low phosphorus, however, a drop in the second quarter of 1956 left stocks little higher than at the end of 1954/55. Scrap stocks, after a small decrease in the first quarter of 1956, rose in the second quarter to 249,000 tons—comparing with 198,000 tons at the end of the second quarter of 1955. The pig-iron charge for 1955/56 was 2,489,000 tons, an increase of 2 per cent. over the previous year. As the scrap charge at 3,154,000 showed only a slightly greater rate of increase, little change in the scrap ratio was experienced over the year, though the figures for the second quarter suggested some rise in the scrap ratio at the end of the period.

TABLE I.—*Iron-castings Production, According to Use. (Grey and Malleable.)*

	Main fields of consumption.	1953 (tons).	1954 (tons).	1955 (tons).
1	Buildings and municipal (pipes, gutters, manhole covers, baths, sanitary goods)	293,799	301,605	315,998
2	Cooking and heating apparatus, including radiators ..	223,659	230,319	225,349
3	Other domestic appliances ..	10,768	13,106	11,365
4	Pipes and fittings for gas, water, sewage, etc. ..	683,338	710,470	702,609
5	Coal mining	38,837	37,339	38,788
6	Gas and chemical plant ..	55,554	52,765	47,188
7	Electricity generation and distribution	80,761	85,832	102,608
8	Motor-car and cycle industry (excluding tractors) ..	271,357	316,004	363,224
9	Railway equipment ..	328,638	311,294	278,869
10	Shipbuilding	99,399	90,333	80,703
11	Prime movers (turbines, engines) for land use ..	79,433	83,810	95,891
12	Boiler-house plant for industry, etc.	63,947	60,658	54,843
13	Agriculture and food processing (including tractors)	162,121	204,294	228,714
14	Machine tools	182,711	178,061	203,378
15	Textile machinery ..	122,421	132,486	135,709
16	Valves, pumps and compressors	70,925	70,766	88,033
17	Ingot moulds for steel and non-ferrous metal manufacture	374,471	352,107	378,258
18	Iron and steel works plant and rolls for mills	131,199	121,891	129,200
19	Cranes and conveyors for industry, transport, etc. ..	37,486	39,324	50,151
20	Printing and paper machinery	22,767	25,723	31,269
21	Other fields	304,838	324,305	362,919
	Total	3,638,429	3,742,492	3,925,066

After an increase in numbers from 138,668 persons at the end of July, 1954, to 146,505 at the end of January, 1956, the ironfoundry labour force has been decreasing. The rate of decrease rose significantly towards the end of the period. The fall in numbers employed in June, 1956, was 1,423 and the total reduction for the five months February to June, 1956, was 3,162—equal to over 2 per cent. of the total numbers employed. Some of this contraction in labour force is due no doubt to the difficult conditions prevailing in the motor industry, but it is notable that while the percentage contraction in the Midlands is high, some measure of contraction has been experienced in all the main producing areas and has been greatest in Scotland where there is a heavy concentration of light-castings manufacture.

Iron and Steel Board

The last annual report referred to the forecast of iron castings production in 1960 which had been submitted to and accepted by the Board. This forecast is now being extended to 1962 to bring it into line with a forecast of steel production in that year. The basic economic assumptions upon which the JIC were requested to make the forecast have been discussed in detail with the Board's officials. After consultation with representative organizations including the JIC, the Board has reduced the levies made to provide the Board's funds. As from September 2, 1956, the levy will be 3d. per ton on all leviable steel ingots and 2½d. per ton on all blast-furnace iron, except basic iron.

The quarterly meetings with the whole-time members of the Board have continued. Among other matters discussed with the Board were the price control of iron and steel scrap, tariffs, foundry pig-iron supplies, ironfounding development, the Restrictive Trade Practices Act, the Clean Air Act, and the collection and publication of statistics.

Price Control of Iron and Steel Scrap

The operation of the Iron and Steel Scrap Order 1955 (S.I. 1955/799) was reviewed at a meeting in November, 1955, by a working party originally set up by the Ministry of Supply. The Board of Trade had by that time assumed responsibility for the iron and steel industry and the Board accepted the view of the working party that the changes made in the Order had achieved the desired results of improving the distribution of scrap in certain areas. No further changes in the Order were recommended.

On May 4th, 1956, the Board of Trade increased the maximum permitted prices of iron and steel scrap by an average of £2 per ton. This news was received with disappointment by the executive, the more so because it came at a time when the Government was urging industry to take all possible steps to defeat inflation by holding the prices of its products. The Council of Ironfoundry Associations, supported by the JIC, protested to the Iron and Steel Board about this ill-timed and unnecessary increase.

Coal and Coke

The past year has seen two substantial increases in coal prices which brought with them consequential rises in the price of both blast-furnace and foundry coke. In June, 1956, the National Coal Board announced that it hoped to maintain the present prices of coal for at least twelve months. Since wages account for 60 per cent. of the cost of production of coal this hope is clearly dependent upon there being no wage increases in that period.

The NCB issued its revision of the "Plan for Coal" in April, 1956. The estimate of coal output in 1965 is 240 million tons, the same as that forecast in the original plan. There are, however, changes in the expected production in certain divisions, notably the North Eastern and the South Western divisions which together show a reduction of 9.2 million tons from that originally forecast. Although these two areas produce the bulk of the carbonization coals, the NCB expects production of

these grades to increase by 11 million tons by 1965. The Board states that it expects to be able to meet the prospective demands from users requiring these special types, although there will undoubtedly be problems in re-distributing the available supplies of carbonization coal.

Clean Air Act

The Clean Air Act has now reached the Statute Book and it brings with it a fresh crop of problems for the industry to face. In seeking to comply with its provisions the industry will inevitably be faced with additional expenditure. The Government's action in introducing this measure received widespread public support. This was recognized by the executive which sought to ensure that its effects on the industry were not unduly onerous. A representative of the JIC was nominated to serve on the Air Pollution Panel of the Federation of British Industries. The Panel served to co-ordinate industry's objections to the Government's proposals on points of detail. Throughout these negotiations the executive had in mind that an application should be made for the scheduling of the industry's processes, thus placing them under the supervision of the Alkali Inspectorate instead of the local authorities, which will be responsible for the enforcement of the Act. At one stage it was found necessary, with the collaboration of the FBI, to promote an amendment to two sections of the Bill in the House of Lords. The amendments were not accepted by the Government. These sections as originally drafted did not affect cupolas, but a Government amendment brought some cupolas within their scope. The Council's amendment sought to remedy this position.

The sections of the Act dealing with air pollution by industrial processes will probably come into force in 1958. The responsibility for the enforcement of the Act will lie with the local authorities, with the exception of those processes which are scheduled for supervision by the Alkali Inspectorate. Before the Minister schedules a process he must hold a public enquiry. It is expected that this enquiry will be held before 1958. Applications for the scheduling of the industry's processes will be made as soon as the arrangements for the public enquiry are known. In view of the common interest, close co-operation is being maintained with the British Iron and Steel Federation and the British Steel Founders' Association.

Training and Education

The CFA's Recruitment, Training and Education Committee exists to keep under review the supply and training of personnel at all levels to meet the changing needs of the ironfounding industry. As a matter of policy, the Committee seeks to ensure that existing facilities for training foundry personnel are used to the maximum advantage by ironfounders, and to sponsor or initiate new ventures when the existing facilities appear to be inadequate or a special need exists. In keeping with this policy, the year under review has seen the growth of closer liaison between the Committee and the National Foundry College and the National Foundry Craft Training Centre (both of which have continued to receive the support of the executive). At the same time, the work initiated by the Committee in the field of supervisory training has been consolidated and its further extension is contemplated.

The Committee has watched closely the important developments during the year in the field of technical education generally. A statement has been submitted to the Minister of Education on the Government's plans for fostering technical education, which were published in February, 1956, and on the introduction of the diploma in technology. Special attention has been drawn to the needs of small firms, and the Committee has expressed the hope that arrangements will be made to enable small firms to participate in and benefit from the expansion of higher technological education, particularly through "sandwich courses."

The status and function of the National Foundry College are not directly affected by the Government's proposals, but the introduction of the diploma in technology may ultimately be of considerable significance for the College, as indeed for technical education generally. Careful consideration is already being given to this matter, and meanwhile efforts are continuing to bring home to all ironfounders the fact that the College-trained man will have an increasingly important part to play in the future development of the ironfounding industry.

On the recommendation of the CFA Training Committee, the executive has agreed to establish a research scholarship in a branch of foundry work in the Department of Industrial Metallurgy at Birmingham University. The need for better qualified personnel in greater numbers has become increasingly apparent during the year, and the recommendation of the CFA Training Committee that this subject should be examined at a conference of executives met with strong support from the executive. Arrangements have therefore been put in hand for such a conference to be held in London in November, 1956.

The short residential programme of training for ironfounding supervisors, initiated in 1955, has been firmly established. The three courses held at the hostel of the National Foundry College during the year under review have been highly successful. In the light of the experience gained, the Committee has decided to make these courses a regular feature, and at the same time is considering whether a need exists for other types of short course.

The year has seen a further increase in the use made of the National Foundry Craft Training Centre by ironfounders. The practical training given to apprentices at the Centre, coupled with the benefits they derive from residence for periods of a month at a time at the Centre hostel, have continued to win high praise from ironfounding employers. A detailed report on the amenities, furnishing and general operation of the hostel was made to the management committee by the Industrial Welfare Society during the year, and considerable re-equipment has since taken place. A new brochure describing the Centre has attracted widespread interest among employers who have not yet made

use of the services offered. The indications are that the Centre will be filled to capacity during the calendar year 1957, and that subsequent development in this form of craft training will depend on the provision of a new Centre.

Health and Safety in Ironfoundries

During the course of the year the CFA safety committee has given a good deal of attention to the incidence of pneumoconiosis in ironfoundries. From the investigations already made by the committee it is clear that more information is needed. The employer's liability aspect of this problem has caused much concern although this may be clarified by a case in which the decision of the courts is awaited.

Two other particular matters dealt with by the committee have been the safe design of foundry plant and machinery, and the design of eye protection. Discussions have been held on the former with the Foundry Trades Equipment and Supplies Association and H.M. Chief Inspector of Factories. The latter subject is being considered by a special committee set up by H.M. Chief Inspector on which the CFA is represented. This committee has done valuable work in studying the design of eye protection for use by men handling molten metal.

The safety committee has considered three interesting reports which have been published during the year. The report of the British Cast Iron Research conference on foundry ventilation and dust control which was held in April, 1955, contains much useful information, both for foundry managements and ventilating engineers. The Joint Standing Committee on Conditions in Ironfoundries issued its first report reviewing the results of the first seven years' work of the Committee. The report of the industrial safety sub-committee of the National Joint Advisory Council deals entirely with accident prevention. For the first time representatives of employers and trades unions have jointly made a general review on a national basis of the whole field of industrial accident prevention. The report contains many recommendations for action in the actual shops. The CFA safety committee has studied the report carefully and has been encouraged to find that the majority of recommendations to employers' organizations are already implemented by the CFA. That does not mean that the committee is satisfied; the toll of accidents is too great to allow complacency to prevail.

Research and Development

The close connection between the Joint Iron Council and the British Cast Iron Research Association has continued to benefit the industry. The increased financial contribution of the Joint Iron Council has made it possible for the Association to extend its activities and plan more effectively for the future. Co-operation between the Council and the Association enables policy decisions to be based on an appreciation of the technical considerations involved and avoids duplication of effort.

The Council has supported research by the British Iron and Steel Research Association in connection with pig-iron production and has increased its grant for this purpose in the current year. The Council's grant to the Institute of British Foundrymen has been expended on staff and meetings expenses of the various technical committees and on the printing of a report on internal stress in castings.

Transport

The JIC lodged an objection to the Railway Merchandise Charges Scheme which was submitted by the British Transport Commission to the Transport Tribunal for approval. The terms were prepared in collaboration with the British Iron and Steel Federation and fully supported the objection made by the Federation. The results of these and other objections were satisfactory. The amendments made to the Scheme by the Tribunal have been set out in an interim decision of the Tribunal. The final decision will contain the amended scheme and will nominate the day on which the scheme is to come into operation.

Tariffs

In January, 1956, negotiations under the General Agreement for Tariffs and Trade began at Geneva. Prior to these discussions the Iron and Steel Board on behalf of the Board of Trade consulted the JIC on the possibilities of a reduction in the rates of import duties on particular items in the UK tariff. Certain of the CFA constituent associations held direct discussions with the Iron and Steel Board and the Board of Trade because of the specialist nature of their products. In addition several other associations were represented at a joint meeting with the two Boards. A written submission by the CFA to the Board of Trade argued the case against any reductions in the rates of duty. In the event some reductions were conceded by the Government's representatives at Geneva. Details of these have been published in the *CFA Bulletins*. Import duties on pig-iron were suspended until September, 1956, by the Import Duties (Exemption) (No. 11) Order, 1955. Subsequently the suspension was continued until March, 1957.

Restrictive Trade Practices Act

The election manifesto of the Conservative Party promised legislation to deal with restrictive practices and within twelve months of being returned to office the Conservative Government secured a second reading for the Restrictive Trade Practices Bill. Less than six months later, this important piece of legislation received the Royal Assent. The executive followed the progress of the Bill carefully, not because the JIC operates any restrictive practices but in pursuance of its policy of studying all legislation likely to affect industry, so that steps can be taken to safeguard the interests of the iron industry where necessary.

Convention and Banquet

The convention and banquet were held in London on November 1, 1955. The morning session was devoted, as usual, to consideration of the annual

(Continued on page 610)

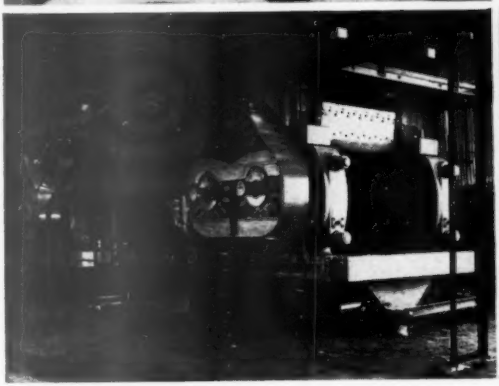
Sugar-mill Pinions in Record Time

Salford Founders Respond to Engineers' SOS

The sugar-cane crushing season was at its height in South America, when, in response to an urgent request from George Fletcher & Company, Limited, of Derby, David Brown Industries Limited (Jackson Division), of Salford, recently completed an order for a set of three machine-moulded, sugar-mill pinions in record time.

Each pinion weighed 1½ tons and had 16 teeth of 7.412-in. circular pitch. The face width in each case was 18 in., and the outside diameter of 43¾ in. Required as spares for a sugar-cane factory in South America, these pinions transmit the drive from a prime mover (which may be a steam turbine or engine) to the three rollers of a heavy cane-crushing mill. They are designed for heavy-duty work at varying centres, and required to work almost continuously for up to nine months in the year.

After tooth block patterns were received at the Salford foundry, moulds (Fig. 1) were prepared and the three castings poured within a week. In order to save time, the moulds were knocked-out while still red hot and fettling (bottom right) was carried out immediately afterwards. The castings were then machined, painted and despatched by road to Liverpool, where they were shipped just twelve days after the job had been received at the foundry. The illustration (bottom left) shows pinions assembled in the complete machine.



Stages in the production of sugar-mill pinions. FIG. 1 *(left).—Preparing the mould in readiness for casting. (Bottom right).—Fettling carried out while the mould was still hot and (bottom left).—Two crushing mills assembled at the Derby works of George Fletcher & Company, Limited, showing the arrangement of the David Brown pinions.*

High Canadian Steel Output

Canadian steel ingot production in October—at 449,114 tons—was 9 per cent. above that of the October, 1955, level of 409,466 tons, while the total for the first 10 months of this year was up by 19 per cent.—4,306,541 tons compared with 3,620,267 tons.

Pig-iron production last month rose by 5 per cent. to 308,273 tons, the 10-month total being up by 11 per cent. to 2,956,149 tons.

RTB's Acquisition

The Iron and Steel Holding and Realization Agency has transferred its direct holding of the whole issued capital of Partridge, Jones & John Paton, Limited, Newport (Mon), to Richard Thomas & Baldwins, Limited.

The operation is an internal one since Richard Thomas & Baldwins has yet to be denationalized. The issued share capital of Partridge, Jones & John Paton is £2,146,188 in £1 shares.

Four Reasons for Sentinel Loss

Four principal reasons are given for the net loss of £635,565 incurred by Sentinel (Shrewsbury), Limited, in the year ended March 31 last. The loss compares with a previous deficit of £124,747.

Added to the lack of demand for old products and the need to prepare for new; the unprofitable substantial sub-contract work; the necessity to write off jigs, tools, and patterns on old products, was the urgent necessity to reorganize completely the factory for greater production.

The company was recently bought from Metal Industries, Limited, by Rolls-Royce, Limited, and after deducting subvention payments of £614,951 (£98,000) from associated companies, there remains a net loss of £20,614 against a previous debit of £26,747. The preference dividend is paid to December 31 last, no payment being made for the half year to June 30, 1956.

Additional finance was supplied by Metal Industries by loaning a further £1,141,000 during the year. The breakdown was £255,000 on capital expenditure, £300,000 on increases in stock, work-in-progress, debtors, etc., and £636,000 less £50,000 depreciation on losses incurred during the work of reconstruction. The balance-sheet shows £616,193 (£101,572) due by group companies and £1,190,618 (£142,001) due to such companies. Stock and work-in-progress is now £1,233,351 (£1,024,420).

The directors state that a great deal of preparatory work has been undertaken in designing, jigging, and tooling and in the factory layout, for the production of electro-mechanical unit heads. Progress is described as "most encouraging."

Joint Iron Council

(*Continued from page* 608)

report. The afternoon session provided for the presentation and discussion of a series of short papers covering the whole field of activity of the British Cast Iron Research Association. A report of the proceedings was widely distributed in the industry as a means of increasing the knowledge and use of the services of the Association.

Publications

In the autumn of 1955, an important paper entitled "Safety in the Ironfoundry," by Mr. Colin Gresty, chairman of the CFA safety committee, was widely distributed and very favourably reviewed. The serial issue to member-firms of "The Elements of Foundry Costing" was completed. The series has been revised and will be reprinted in book form. A development in the field of technical publicity was the negotiation with the holders of the copyright for the translation and publication of a French work.—*A Practical Guide to the Design of Grey-iron Castings for Engineering Purposes.* Two publications arising from the work of the CFA training and education committee appeared during the year, namely, a new and revised edition of the recruitment booklet *Boys! Choosing Your Career?* and a descriptive list of visual aids obtainable from the CFA, under the title *Instruction in Ironfounding.* An informative article on the need for the industry to pay greater attention to the facilities for higher technical training offered by the National Foundry College appeared in the FOUNDRY TRADE JOURNAL of May 24, 1956.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

758,121. Gebr. Bohler & Company, A.G., 14 Elisabethstrasse, Vienna, 1, Austria.

Continuous casting of billets. During the passage through the cooling tract, outside the chill mould, the increase (in successive equal intervals of time) in the wall thickness of the solidified portion of the billet remains constant.

758,193. Foundry Services, Limited, Long Acre, Nechells, Birmingham.

A heat-producing mixture designed for insertion in molten metal in such a form as will ensure that the metal remains molten for the time desired, *e.g.*, in large castings, up to four hours may be desired. The mixture comprises a shaped body (such as a cylinder or similar) consisting of aluminium, an amount of oxidizing agent well below the amount needed to react with the aluminium to oxidize it completely, and 1 to 5 per cent. by weight of a fluoride. This is inserted into the molten metal about the centre of the feeding head. A number of these bodies may, of course, be successively employed to retain heat in a casting for a longer time.

758,246. Newton Chambers & Company, Limited, Thorncliffe Ironworks, near Sheffield.

Improvements in cupola furnaces and the production of cast iron in them. All the coke burnt to provide the heat required in the furnace is fed laterally into the furnace below the burden in the furnace, but above the level of the molten slag. Carbon monoxide produced by the combustion of the coke is burnt under or within the burden by secondary air admitted not lower than the top of the coke bed.

758,494. Ri-Ri Werke A.G., Mendrisio, Tessin, Switzerland.

Improvements in the manufacture of sliding clasp fasteners by die-casting the interlocking members directly on the stringers in rows. Each of the two parts of a two part mould is provided with at least four rows of recesses for directly moulding interlocking members to at least four stringers. The mould has a middle portion which is arranged transversely to the stringers and includes a casting channel having access to the recesses *via* transversely extending gutters. Covers are also provided for those portions of the stringers over which the transversely extending gutters pass.

758,529. Steel Company of Wales Limited, Abbey Works, Port Talbot, Glamorgan, Wales, together with A. J. Kesterton, and A. V. Williams, both of the company's address.

This patent relates to the application of oxygen in the manufacture of steel in open-hearth furnaces. A liquid-cooled delivery pipe capable of directing oxygen to impinge on the charge, is retractably mounted upon the furnace and is capable of being controllably lowered into the furnace through a hole in the roof. By this method the normal operations of the furnace are not interfered with in any way.

THE Cummins Engine Company has been formed with an initial capital of £100,000. The company—a branch of the Cummins Engine Company of America—is establishing a plant at Shotts (Lanarkshire) and is to make diesel engines.

Bletchley Equipment Works

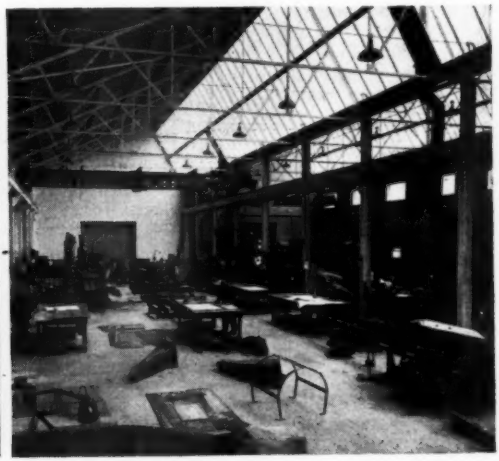
New Shops of Foundry Mechanisations (Baillot) Limited

Large new workshops for the manufacture and assembly of foundry equipment have recently come into production at Bletchley, Buckinghamshire. These are the premises, situated on the local trading estate (just off the main A.5 road, Watling Street), of Foundry Mechanisations (Baillot) Limited, controlled by Mr. E. R. Millac, himself a foundryman (he was apprenticed with Bonvillain & Ronceray, of France). A JOURNAL representative who recently visited the Bletchley works (Figs. 1 to 3) found them well laid-out, eminently suited to their purpose, and producing a high-class, competently designed and comprehensive range of equipment. As the name suggests, the products fall mainly into mechanization projects, including continuous and semi-continuous casting plants, with particular bias towards complete sand-preparation and reconditioning plants. Also, as suggested by the name of the firm, there is a close association on design matters with the French firm, Alfred Baillot & Cie., established since 1909 as makers of foundry equipment. In the category of manufactures are incorporated the well-known Baillot continuous sand mills, in addition to hoppers, elevators, conveyors, screens and feeders of orthodox basic design but each with minor features special to the firm, also a range of disintegrators, and mould conveyors.

Construction and Layout

The new premises consist of two main bays each about 120 by 35 ft. making 10,000 sq. ft. of floor-space, of height 14 ft. to the crane rails. The shops were built to the firm's own requirements, the job being done in two stages, *i.e.*, before the single bay, which was first intended to comprise

FIG. 1.—*Exterior and Figs.* 2 *and* 3 *interior views of the Bletchley works of Foundry Mechanisations (Baillot) Limited.* FIG. 2. *shows the bay devoted to machining and fitting, with a number of items ready for despatch and* FIG. 3 *illustrates the bay where steel constructional work is carried out.*



Bletchley Equipment Works

the works, was properly completed the need for a second bay to cope with the volume of business accumulating in 1955 was realized, and the extension put in hand. In each bay there is a 5-ton capacity electric overhead travelling crane, of Felco manufacture. Production commenced in May 1955 in the first shop to be completed.

Plant Installed

Bay one is mainly devoted to machining operations and contains, in addition to two large radial drills (and sundry smaller items of plant), a large horizontal planing machine, of table size 10 ft. by 4 ft.; several centre-lathes (the largest swinging 4 ft. dia. by 10 ft. between centres), smaller drills, a tool-and-cutter grinder, milling machine and shaper. The second bay is devoted to erection, assembly and steel-plate work (sand hoppers and the like are fabricated here) and contains mechanical hacksaw, guillotine, and welding and cutting equipment, both the oxy-acetylene and electric processes being employed. A stand grinder completes the list of major items of equipment in this section. The shops are heated—and most efficiently too—by two oil-fired units by "Zephair" of capacity 500,000 BTU per hour, each, and the northlight type of roofing incorporates a number of Colt ventilators.

Work in Progress and Completed

The writer, naturally, was interested in work in progress and projects completed. Amongst the former were a number of hoppers, delivery belts, short, heavy-duty roller conveyors, and various items of sand plant, including different models of the Baillot mills. Excepting moulding machines, the company, even at this early stage, handles practically every other plant requirement of a modern foundry and some new designs are being developed and are soon expected to be on the market, extending the range to cope also with mould making. It is understood that a manufacturing licence agreement is being entered into for the manufacture in this country of the well known "Benoto" system of cupola charging.

Amongst projects recently completed is a system for a large Yorkshire foundry comprising a 60-ton per hour sand-handling plant (two 30-ton per hour continuous mills and all ancillary equipment, including some novel ideas on sand distribution). Here, Badische Maschinenfabrik moulding machines are being served by the new plant.

For the iron foundry of Kent Alloys, Limited, Rochester, a 10- to 15-tons per hour sand plant has been installed and it is a source of pride that two days after completion of the erection, it was working to full capacity—not often can such commendable absence of "teething troubles" be claimed. This installation comprises complete sand-treatment and distribution to serve nine existing moulding machines, based on the full utilization of the output from one continuous sand mill. From the knock-out (which is Sturtevant exhausted) the sand goes by underground belt to a bucket elevator delivering into a rotary screen seated on top of a single 40-ton storage hopper. Subsequently, there is a belt distribution to the mill where a special feature is made of the incorporation of coal-dust and bentonite automatically to the sand by means of hoppers and small belts. After the mill, the sand is elevated and passed through a disintegrator situated above the distribution belt feeding the individual moulding-machine hoppers. A magnetic separator of the "Overband" type is incorporated close to the knock-out. This plant produces general engineering iron castings; it is expected that a second plant, but of larger capacity, for the same firm will shortly be in production.

Future

It would seem this Bletchley works has a bright future in store and indeed, this impression is enhanced by the manufacturing precision and careful supervision which are seen as part of the normal shop routine. The possibility of future extension has not been lost sight of, and land has been acquired which could permit a doubling of the present size of the works. New designs are being added to an already comprehensive range. The opinion is strengthened that with this installation, as with others recently described in this JOURNAL, the equipment and supplies' industry of this country shows itself well capable of catering for the more and more exacting needs of founders.

Student Apprentices' Association

An Association to be known as the RapieR Student Apprentices' Association, was formed at a meeting recently held at the Waterside Works, Ipswich, of Ransomes & Rapier, Limited. It has been formed to promote discussion and interchange of ideas between student apprentices, and to arrange tours of inspection of other works and installations of technical interest to mechanical, electrical, structural and production engineers.

In the opinion of Mr. Dare, works director, the Association will be of considerable value to the company as well as to the students, as it will enable the firm to continue its long-established policy of finding its executives, designers, and managerial staff, within the ranks of its own apprentices, which was the one best way of combating the nation-wide shortage of technologists.

Staveley Coal & Iron's Report

Discovery and invention would, in the near future, give further impetus to the developments of electronics in industry in which the Staveley Coal & Iron Company, Limited, had a part to play, states the chairman, Mr. Thomas A. McKenna, in his annual review.

Internal reorganization of the subsidiaries had continued and a number had made issues of shares to the parent company for cash, in order to improve their liquid position. Turnover and work in progress for the year ended June 30, 1956, increased substantially, but profit margins were narrowed.

Group net profit is £1,007,108 (£1,052,912) and the dividend is 15 per cent. (same). Group assets amount to £17,570,000 (£17,260,000), and stocks are up from £3,470,000 to £5,100,000; group commitments with third parties for capital outlay are £373,000. £330,000 worth of contracts have been approved since June.

Anglo-Australian Trade Agreement

Early next year the new Anglo-Australian trade agreement will be concluded, and it is calculated to go a considerable way to bringing trading conditions between the two countries on to a more modern footing than that imposed by the Ottawa Agreement of 1932.

Among its effects will be to reduce the levels of preference to new guaranteed margins of 7½ per cent. on capital goods and 10 per cent. on most other goods. Hitherto the minimum margins accorded to most British manufacturers have ranged between 12½ per cent. and 17½ per cent.

In Australia, Mr. Latham Withall, director of the Associated Chambers of Manufacturers, has stated that the reduced margins of preference would do little harm to Britain, and he doubted whether there would be much diversion of trade. The margin of preference in favour of UK goods should secure Britain a sound share in Australia's trade.

During negotiations, specific arrangements were also made for close consultation on many trade matters, including anti-dumping, countervailing duties, transport and communications, and disposal of surpluses.

The existing guaranteed margins are to be maintained on zinc and lead. A margin of preference of 7½ per cent. is fixed for:—Iron and steel hoop (defined gauges and widths); aluminium and nickel; primary shapes of non-ferrous alloys; tinplate; agricultural, horticultural and viticultural machinery; steam-engine indicators, revolution and speed counters; zinc-refining retorts; earthmoving, mining, and metallurgical machinery; field mowers; machines and machine tools; ball and roller bearings; metalworking lathes; road-making, cementmaking, and stone-crushing machines, cranes, conveyors, etc.; tools, inserted type, cemented carbide; measuring and controlling instruments; sugar machinery; woodworking machines; air and gas compressors and exhausters; portable hand tools; locomotives; tractor parts; steam and water turbines and parts; internal combustion engines; boilers and steam turbines; circuit breakers, switch units; lightning arresters for power stations; voltage regulators; relays for power stations and other purposes; electrical control equipment; switches, fuses, cut-outs, relays; electrical regulating, starting, and controlling apparatus; dynamo electric machines; static transformers; covered cable and wire; electrical measuring and recording instruments; chain and chains of base metal; hand tools; Portland cement, original equipment components for motor vehicles; fork-lift and elevating platform trucks; metal cordage.

ACC-Vickers-Babcock

Arrangements for the formation of a company to be known as ACC-Vickers-Babcock (Private), Limited (A.V.B.), have been concluded by Associated Cement Companies, Limited, Bombay, Vickers, Limited, London, and Babcock & Wilcox, Limited, London.

The new company plans to build a heavy-engineering works in the vicinity of Durgapur, west Bengal. The products to be manufactured will include cement-making machinery, mining machinery, large pumps, heavy gears, steam generating plant of all types, pressure vessels, cranes, and mechanical handling equipment.

The construction of the proposed works will commence as soon as the Government of India's approval has been obtained.

Brush Group Re-organization

The heavy marine engine business of the Brush Group, Limited, is now conducted under the auspices of two separate companies to be known as Associated British Oil Engines Marine (Mirrlees), Limited, and Associated British Oil Engines Marine (National), Limited. The re-organization has taken place to ensure adequate service to customers and to deal with the commitments of a rapidly expanding market for Mirrlees and National marine engines.

The sales force has been regrouped into individual units dealing separately with Mirrlees and National sales, permitting closer personal contact between customers and group marine representation. In addition advantages of more specialized selling as related to owners' specific technical problems, can be offered.

The directorates of the individual companies will be:—Associated British Oil Engines Marine (Mirrlees), Limited: Mr. Ian T. Morrow; Mr. C. F. Barnard; Mr. J. Calderwood; Mr. R. Hunter; Rear-Admiral I. Maclean, and Mr. B. H. Mears. Associated British Oil Engines Marine (National), Limited; Mr. Ian T. Morrow; Mr. S. Webster; Mr. J. Calderwood; Mr. H. B. MacAuslan; Rear-Admiral I. Maclean; Mr. D. W. Mansell, and Mr. J. Jones. Mr. R. Hunter and Mr. H. B. MacAuslan will act in the capacity of executive directors in each case.

British Oxygen's Three-year Plan

For some years, the British Oxygen Company, Limited, has been working actively with the steel industry to bring advanced steelmaking processes to fruition. Use of oxygen in very large quantities to obtain larger output and lower costs, is involved, and for the next three years the company has a £30,000,000 development programme.

Part of the programme is a £10,000,000 debenture issue. The application list of the 5¼ per cent. debenture stock 1981-86 at a price of 98, will be opened tomorrow, and preferential consideration will be given to members of the company registered on November 9.

The proceeds of the issue will be £9,525,000 and about £3,500,000 will be used to repay bank overdraft. A further £5,000,000 is to be spent on "tonnage" oxygen plants for the supply of an aggregate annual quantity of 10,000,000,000 cub. ft. of oxygen and 3,000,000,000 cub. ft. of nitrogen. This is in addition to an extra 3,000,000,000 cub. ft. of oxygen to meet normal expansion of sales for industrial and general use. Substantial projects are also planned for Commonwealth countries.

Possible Expansion of G. & J. Weir

The directors of Wm. Simons & Company, Limited, engineers, etc., of Renfrew, have received from G. & J. Weir, Limited, engineers and founders, of Glasgow, two new and separate offers to purchase, respectively, the whole of the issued preference share capital of the company, comprising 12,500 5 per cent. cumulative preference shares of £10 each at the increased price of £10 per share, and the whole of the issued ordinary share capital, comprising 25,000 ordinary shares of £17 10s. per share.

The offer is conditional upon its acceptance by November 29, or such date as G. & J. Weir may decide, in respect of not less than 90 per cent. of the issued shares of each class, and in addition the offer for the preference shares is also conditional on the acceptance of the offer for the ordinary shares. The directors recommend acceptance.

Company News

INDIAN IRON & STEEL COMPANY, LIMITED—Sales of products in the year to March 31, 1956, were £20,239,717 (£18,415,268 in the previous year). After all provisions and charges, net profit is £488,879 (£502,444). The amount carried forward is £33,699 (£34,830).

SAMUEL OSBORN & COMPANY, LIMITED—The dividend is being raised by 5 per cent. to 32½ per cent. for the year to July 31, 1956, with a final of 20 (15) per cent. Group profits, before tax, expanded by about £364,300 to £1,300,184 and the net balance is up from £503,901 to £641,043. In addition to normal depreciation of £248,690, a supplementary provision of £120,000 has been charged.

JOHNSON & PHILLIPS, LIMITED, electrical engineers, cable makers, etc., of London, S.E.7—Interim dividend for 1956 on the £1,667,187 ordinary capital is cut from 7½ per cent. to 5 per cent. (total for 1955, 15 per cent.). While recent orders show a definite improvement, the directors regret that trading results for the first eight months (including overseas branches) are such that any higher interim would not be justified.

SPENCER (MELKSHAM), LIMITED, manufacturers of elevating, conveying, and conditioning plants—The company is to pay 12½ per cent. on doubled capital for the year to October 2, 1956, against 15 per cent. before a 100 per cent. scrip issue. The cost is £29,679 (£17,807). Untaxed profit is £245,420 (£226,482). Taxation absorbs £125,622 (£108,600). Profit is after crediting retention moneys in respect of contracts completed in previous year amounting to £10,966 (£19,829).

HEENAN GROUP, LIMITED—For the first time in the history of the group, profits before taxation have passed the £500,000 mark (£505,900 compared with £449,485). A final dividend on the £537,584 ordinary capital of 15 per cent., making 20 per cent. (same) is recommended. It is proposed to increase the authorized capital to £1,600,000 and to capitalize £537,584 of reserves so as to distribute one ordinary 5s. share for each share held. The shares will not rank for 1955-56 dividend.

BIRMINGHAM SMALL ARMS COMPANY, LIMITED—The ordinary dividend for the year ended July 31 is cut to 8 per cent. (10 per cent.). Trading profits dropped to £1,604,941 (£2,865,676) and net profits were returned at £914.887 (£1.313.455) after taking into account a profit of £239,236 (£9,571) on disposal of fixed assets, etc. The machine tool and steel businesses are reported to have had a most successful year with improved results. Trading profits of the motor-cycle companies were less and the motor-car industry sustained severe losses.

JOHN I. THORNYCROFT & COMPANY, LIMITED—Performance cannot be judged on one year's results because contracts and results from development expenditure run over a much longer period, states the chairman, Mr. J. E. Thornycroft. Group profits in the year ending July 31 declined from £1,159,304 to £793,155. Stock and work-in-progress is up from £2,713,535 to £3,488,172. Orders on hand will keep the labour available fully employed for at least a year, but Mr. Thornycroft sees no simple solution to hold or reduce costs. The dividend is reduced from 15 per cent. to 12½ per cent. with the final payment cut from 10 per cent. to 7½ per cent.

Forthcoming Events

NOVEMBER 26

Institution of Works Managers

Glasgow branch:—"History of Non-destructive Testing," by J. J. Gillespie, 7.30 p.m., at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, C.2.

NOVEMBER 27

Sheffield Metallurgical Association

"Feeding Compounds," by D. W. Leonard, 7 p.m., at the British Iron and Steel Research Association Laboratories, Hoyle Street, Sheffield, 3.

NOVEMBER 28

Institute of British Foundrymen

Birmingham, Coventry and West Midlands branch:—"Hot-blast Cupola Practice," by E. Löbbecke, 7.15 p.m., at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Institution of Production Engineers

Worcester section:—"Process Development of Shell Moulding," by J. Fallows, 7.30 p.m., at the Cadena Café.

NOVEMBER 29

Institute of British Foundrymen

Northampton section:—"Carbon-dioxide Process," by D. V. Atterton, 7.30 p.m., at the Hind Hotel, Wellingborough.

Incorporated Plant Engineers

Merseyside and N. Wales branch:—"Electrical Hazards," by D. A. Picken, 7.15 p.m., at the Stafford Hotel, City Road, Chester.

Institute of Vitreous Enamellers

Midland section:—"Care and Maintenance of Vitreous-enamelling Plant," 7.30 p.m., at the Birmingham Exchange and Engineering Centre, Stephenson Place.

NOVEMBER 30

Institute of British Foundrymen

Falkirk section:—"Approaches to Automation," by J. Arnott, 7.30 p.m., at the Temperance Café, Lint Riggs.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BALLYMENA, December 3—Supply and erection of all equipment for a water-treatment plant, for the Borough Council. John Taylor & Sons, engineers, Artillery House, Artillery Row, Victoria Street, Westminster, London, S.W.1. (Fee £5, returnable.)

BIRMINGHAM, November 27—Pistons and cylinder liners, for the Transport Committee. Mr. W. H. Smith, general manager, Birmingham City Transport, Council House, Congreve Street, Birmingham, 3.

CEYLON, December 28—Two mobile cranes, for the Tender Board, Ministry of Lands and Land Development. (ESB/28504/56/ICA.)

ETHIOPIA, November 30—Water supply equipment and hand tools, for the Municipality of Addis Ababa. (ESB/27971/56.)

RHODESIA, December 19—Cupola furnace, for the Purchasing Board, Rhodesia Railways. (ESB/28353/56.)

SOUTH AFRICA, November 29—Drilling machines, for the Union Tender and Supplies Board. (ESB/28452/56.)

SOUTH AFRICA, December 7—Pumping plant, for the Stores Department, South African Railways. (ESB/28278/56.)

MASSEY-HARRIS-FERGUSON (MANUFACTURING), LIMITED—Mr. E. W. Young, deputy chairman, has been appointed chairman. He succeeds Col. W. E. Phillips, who has resigned. Mr. J. M. Chambers, Mr. G. Galletly, Mr. T. V. Knox, and Mr. J. H. Taylor have been appointed directors. Mr. G. T. M. Bevan, Mr. L. G. Reid, Mr. I. J. Wallace, and Mr. A. L. Weeks have resigned from the board.

In this type of sand mixer 'FULBOND' ensures an even mix with higher permeability and strength.

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Patteson Court, Nutfield Road, Redhill, Surrey

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CMF. 20

News in Brief

THE NAME of Nevelin Electric Company, Limited, Lancashire Dynamo Switchgear, Limited, has been changed to Lancashire Dynamo Nevelin, Limited.

THOMAS W. WARD, LIMITED, Albion Works, Sheffield, paid a bonus totalling £15,000 to 1,600 hourly paid workers in their works and depots, for the week ending November 17.

COSELEY (STAFFS) YOUTH EMPLOYMENT COMMITTEE report that in the year ended July 31 last, only a small percentage of the boys leaving school went into the foundries, despite the continued stress being laid on that industry.

CATTON & COMPANY, LIMITED, ironfounders, Chadwick Street, Leeds, were visited, on November 16, by five Pakistani industrial welfare and personnel officers who are studying relations between British management and workers.

BOROUGH POLYTECHNIC, Borough Road, London, S.E.1, is organizing a course of five lectures on "Atmospheric Pollution—its Causes, Effects, and Prevention," beginning January 22, 1957. The fee for the course is 10s. Details are available from the secretary of the Polytechnic.

THE 22nd autumn research meeting of the Institution of Gas Engineers was held at Church House, Westminster, London, S.W.1, on November 20 and 21. Among the several papers presented was one on "Forced Recirculation in Industrial Gas Appliances," by Mr. W. E. Francis, B.A.

IN A STATEMENT issued last week, the National Federation of Scrap Iron Steel and Metal Merchants—recognized by the Board of Trade as representing the ferrous scrap trade—says the industry "has no present intention" of asking the Government to agree to a rise in the statutory maximum prices of ferrous scrap.

GENEVA was the venue for a three-day conference this week, organized by the Mond Nickel Company, Limited, to discuss nickel marketing. Under the chairmanship of Mr. J. O. Hitchcock, sales director, such matters as the availability of nickel in relation to industry's expanding requirements internationally, and questions concerning production and distribution of primary nickel products were dealt with.

THE British India Steam Navigation Company, Limited, has confirmed that it has placed an order with Harland & Wolff, Limited, for five motor cargo ships to be built at its Govan yard. These vessels will be about 6,500 tons d.w. and will be employed in the company's eastern trades. They will incorporate a new feature. All accommodation for deck and engineer officers will be fully air conditioned.

THE BOARD OF TRADE announces that a sample census of distribution is to be taken for 1957, but not more than one in 10 of the smaller independent traders will be required to make returns. Forms for completion will not be issued until January, 1958, but specimen copies have been prepared and will be issued shortly to the largest retailers, and to finance houses, check traders, credit traders, and mail-order houses.

THE OWEN ORGANIZATION announce that as from November 14, 1956, their member firms of Salopian Engineers, Limited, and Kenneth Hudson & Son, Limited, will concentrate solely on design and marketing. The agricultural machinery previously made by Salopian Engineers, Limited, will be manufactured by Rubery, Owen & Company, Limited, the parent firm of the organization, and marketing will be handled by Kenneth Hudson & Son, Limited.

W. & T. AVERY, LIMITED, held an "open day" at their Soho Foundry on November 17, the objective being partly to provide facilities for outsiders to see something of this historic workplace associated with Boulton, Murdoch and Watt, and partly to stimulate interest in the company's work and labour recruitment. Although the factory was thrown open to all comers, the invitation was especially extended to personnel with trade and technical skills.

BETWEEN 200 and 300 employees in Coventry factories of the Rootes Group are to be dismissed soon and others are to go on a four-day week, it was announced by a spokesman of the company on November 15. It was stated that this measure was a consequence of the economic and general international situation. Workpeople to be dismissed will be mainly the rest of the 500 men who were declared redundant in September, but have been retained on rotation working.

TANGYES OF CANADA, LIMITED, a subsidiary of Tangyes, Limited, of Smethwick, has secured a contract worth 150,000 dollars for hydraulic equipment which will be used to jack up a 14,000-ton Jacques Cartier bridge over the St. Lawrence River. The aim is to provide increased clearance for shipping. It is thought that the lifting operation will be the biggest of its kind ever attempted. The equipment to be used consists of 18 hydraulic units composed of 500 tons capacity each and 12 of 400 tons capacity.

ALVIS, LIMITED, Coventry, stated on November 14, that there would have to be redundancy and short-time working in the fighting-vehicle assembly shop after the Christmas holidays. Mr. H. J. Dixon, works director, said that a rearrangement of the programme necessitated such a measure. No cancellations of orders are involved and the number of employees affected is less than 5 per cent. of the total. Shop stewards have thanked the management for the length of notice and the way in which the redundancy has been handled.

A MINUTE of the Markets and Fairs Committee to be considered by the Bradford City Council this week indicates a possibility of nearly three acres of Bradford Moor fairground being used for building an extension of the works of Crofts (Engineers), Limited, power transmission engineers, Thornbury, Bradford. The minutes report an application on behalf of the firm for the lease of 2.8 acres, the major portion of the fairground, which adjoins their Empire Works. The committee authorized negotiations with the firm, who want to erect buildings for light industrial purposes.

BAIRDS & SCOTTISH STEEL, LIMITED, has placed an order with the General Electric Company, Limited, for a high-pressure turbo-blower to be installed at Gartsherrie Iron Works, Coatbridge, Lanarkshire. The machine is a turbine-driven centrifugal blower capable of delivering a maximum volume of 60,000 cub. ft. of free air per minute at N.T.P. against a pressure of 16 lb. per sq. in. gauge. The turbine, direct-coupled to the centrifugal blower, is designed to operate at steam inlet conditions of 425 lb. per sq. in. gauge, 375 deg. C. total temperature, and exhausts into a Mirrlees Watson condenser giving a vacuum of 28 in. mercury with cooling water at 80 deg. F. This plant, which will be manufactured at the Fraser & Chalmers Engineering Works of the GEC, is a duplicate of one already installed at the Gartsherrie Iron Works and commissioned in December, 1955.

Whether you want to convey HOT or OILY SAND

– keep down your costs by using 'job-designed' Goodyear belts

Oily shavings . . . hot sinter . . . jagged rocks . . . whatever you want to convey and whatever the operating conditions use a Goodyear belt.

It will keep down costs and keep up efficiency. How? By its rugged 'job-designed' construction.

Every conveyor installation demands what Goodyear offers — the right belt for the job. Goodyear will also help you choose the right belt and advise on any installation, operation or maintenance problems.

QUICK DELIVERY

You can now get quick delivery of Goodyear conveyor belts, which are available with cotton or rayon plies. They can be supplied in a few weeks against specific ordering.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING · TRANSMISSION BELTING · V-BELTS · HOSE · FENDERING

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Personal

Mr. E. KENT has been appointed a member of the board of Le Grand Sutcliff & Gell, Limited.

Mr. JAMES JAMIESON, assistant manager of John Readhead & Sons, Limited, shipbuilders, of South Shields, has retired after 50 years' service.

Mr. JOHN A. DARBY, sales manager for Herbert Terry & Sons, Limited, spring specialists and manufacturers, of Redditch, has completed 40 years' service with the firm.

Mr. KENNETH JAQUES, assistant secretary of the Neepsend Steel & Tool Corporation, Limited, Sheffield, has been elected a Fellow of the Chartered Institute of Secretaries.

Mr. H. H. SHEPHERD, F.I.M., F.R.S.A. (foundry and metallurgical consultant), has recently returned from the Middle East and is planning to re-visit Australia early in 1957.

Mr. CHARLES PRYOR, who began his apprenticeship when craftsmen toolmakers were earning about 29s. a week, has completed 65 years with the Sheffield firm of William Marples, Limited.

Mr. STANLEY N. EVANS who founded the business of Stanley N. Evans, foundry sand suppliers, in 1919, has resigned his seat in the House of Commons, where he represented the Wednesbury, Staffs, constituency.

The council of the Institution of Production Engineers announces that Mr. H. SCHOLES, new products engineer-project engineer of Joseph Lucas Electrical, Limited, Burnley, has been awarded the Schofield travel scholarship for 1956.

Mr. NEIL M. PEECH, chairman and managing director of the Steetley Company, Limited, and a director of the Sheepbridge Engineering Company, Limited, is one of three nominated as Sheriff of Yorkshire. The final choice will be made by the Queen.

Lieut-Col. H. B. RIGGALL, managing director of Ruston & Hornsby Ltd., engineers, Lincoln, slipped and broke his leg on November 12, when he was entering the yard of the Lincoln Sessions House where he was to be chairman of the Magistrates' Court.

Sheffield University Council, on November 16, appointed Dr. A. CRITCHLOW, as lecturer in chemistry, and Dr. A. R. ENTWISLE, lecturer in metallurgy. The resignation of Dr. P. H. PRICE has been received from his post as lecturer in fuel technology. Mr. S. M. de BARTOLOME and Mr. F. PICKWORTH were re-elected to the Council.

Mr. WILFRID R. HARVEY has been appointed manager of the marine department of Babcock & Wilcox, Limited, in succession to Capt. W. GREGSON, who retired on October 31 last. Capt. Gregson is retaining an association with the company as a member of the board and technical adviser to Spencer-Bonecourt-Clarkson, a subsidiary.

Obituary

Mr. DONALD MORRIS, secretary of General Refractories, Limited, Sheffield, since 1951, died suddenly on November 11, at the age of 55. He started with the company in 1936 as cost accountant.

Mr. FREDERICK GEORGE WILEY, who has died at the age of 65, was formerly chairman and managing director of James Wiley & Sons, Limited, malleable iron-founders, etc., of Darlaston, Wednesbury (Staffs).

Sheffield Foundry Exhibition

Displays at Edmund Road Surprise the Industry

For the first time for many years there has been held in this country a foundry exhibition standing on its own. This was the regional show organized jointly by the Sheffield section of the National Trades Technical Societies and the Sheffield branch of the Institute of British Foundrymen, in the Edmund Road Drill Hall, Sheffield, last Wednesday, Thursday, Friday and Saturday. It is too soon afterwards for a final balance to be presented, but the fifty standholders seemed unanimous in pronouncing the exhibition to be a huge success, surpassing the most optimistic forecasts. That this view is justified was proved also by the attendance, which is estimated at least to be 5,000 (admission was free and uncounted), and by the fact that even at closing time on Saturday night (8 p.m.), the halls were by no means empty.

Outstanding Exhibits

It is difficult to pick out which were the most outstanding features.* The display of apprentices' work in the upper hall and the production sequence tableau manned by the apprentices in the lower hall continuously attracted a substantial quota of visitors. Fathers were showing wives and sons their particular jobs in the foundry, and to the parents neophyte foundrymen showed how they were fitting into the foundry scheme. Some of the stands were not manned full-time, and herein possibly a mistake was made, for even a static display of finished castings can evoke discussion profitable to both visitor and exhibitor. Another factor to bear in mind is the attraction of "live" shows. A hot furnace, a moulding machine, a shell-moulder or coremaker in operation, or a working model of a foundry, always bring a good crowd, and though a critic may say it is not a crowd of buyers, there is no doubt that enthusiasm is infectious. Specially noteworthy, too, were the displays devoted to safety equipment, for not only was there a sales angle but it was good propaganda to show how safety and welfare are uppermost in founders' schemes nowadays.

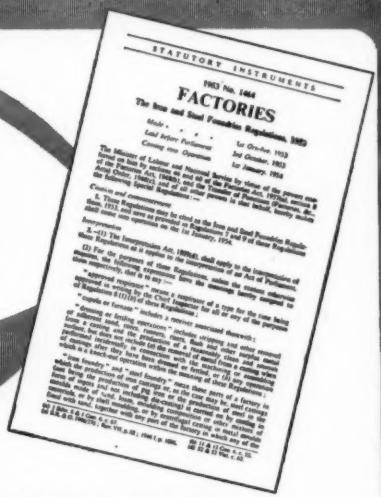
The Lord Mayor of Sheffield, Alderman Robert Neill, who opened the exhibition, recalled his working days in a foundry. Things have changed a lot since then, he said, when all the ramming was done by hand. Perhaps the most pungent statement was made at the opening by Mr. H. J. V. Williams, president of the Institute, who claimed that the foundry industry as a whole was not advertising itself enough. It might almost be said to be resting on its laurels, though this really could not truly be said of development, he said.

A notable feature was the number of organized parties from neighbouring works, and even far afield, which attended the exhibition. A large contingent came from Tees-side, others from Falkirk, the Midlands, Bristol, some from Germany, America, and one exhibitor even reported visitors from Thailand. Thus the success of the exhibition was assured and all those who had a hand in its organization are to be congratulated on showing enterprise and foresight. It proved bigger than they anticipated, and, like a stone thrown into a pond, its ripples may yet spread still wider.

* The stands were described individually in the FOUNDRY TRADE JOURNAL of November 8, pages 529–534.

VILLIERS ENGINEERING COMPANY, LIMITED—Mr. George T. Teasdale has been appointed a director.

for Foundry Floors and Gangways - Refractory Concrete is the Ideal Material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1953 No. 1464

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The Iron and Steel Foundries Regulations, 1953

The Iron and Steel Foundries Regulations 1953 say "Foundry gangways and Pouring Aisles shall have an even surface of hard material, and shall not have on them more sand than is necessary to avoid risk of flying metal from accidental spillage." The use of Refractory Concrete (made with Ciment Fondu and crushed firebricks or grog) will enable you to fulfil these conditions speedily, because Refractory Concrete . . .

. . . has a high cold strength and is ready for full use 24 hours after placing.

. . . will withstand repeated spillages of molten metals and direct contact of hot castings without spitting and blowing.

. . . needs no sand covering.

. . . is non-spalling under widest fluctuations of temperature and highly resistant to all forms of mechanical shock.

Photograph by courtesy of Globe Tank & Foundry (Wolverhampton) Ltd.

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Concrete Rock-Hard within one day

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AP3/130

Raw Material Markets

Iron and Steel

The blast furnaces, of which there are now 100 in operation, are obtaining maximum outputs of pig-iron. For the time being they have plentiful supplies of ore, the increased tonnages from both home and overseas sources having provided sufficient quantities for consumption and also for stocks. The international situation may have an adverse effect on supplies, and there has been some falling-off recently in shipments due chiefly to the shortage of shipping space. Blast-furnace coke is in fairly good supply and, with more coking plants coming into operation, there is every prospect of adequate tonnages being available.

The steelworks maintain their pressing demands for supplies of basic pig-iron, and additional furnaces are needed to relieve the shortage in some areas. The foundries have no difficulty in obtaining their requirements of pig-iron in the suitable grades.

The engineering and speciality foundries producing high-duty castings find no shortage at present in the supply of the low-phosphorus iron and hematite, and for the past few months tonnages on offer have exceeded demand.

As stocks are reduced, and with the prospect of an improvement in production in the motor vehicle trade, there are signs of an upsurge in demands for pig-iron. The small tonnage of low-phosphorus irons which have been shipped abroad have relieved the furnaces of stocks, but little more is likely to be spared for export. Hematite makers are able to dispose of their outputs. Refined iron makers continue to accept orders for overseas customers, as demands from home consumers show very little, if any, expansion.

An improvement at some of the light foundries has resulted in a slightly increased demand for high-phosphorus pig-iron, but overall there is no pressure for this grade and available supplies fully satisfy demands. Jobbing foundries are fairly busy, but the textile foundries are in need of more work. The foundries are fairly well off for scrap and what demands are being made is for heavy cast iron and machinery scrap. Merchants have good stocks of medium and light scrap.

Foundry coke is coming forward satisfactorily so far as deliveries are concerned, although some complaints are raised of the quality and size. Ganister, limestone, and firebricks are received to requirements.

The re-rollers maintain uninterrupted production, as they have the orders and adequate quantities of steel available to enable them to obtain maximum outputs consistent with the manpower available. The latter has shown much improvement in some areas, but in others it is still the cause of reduced production. Home consumers continue to absorb the major portion of all the products of the re-rollers, including small bars, light sections, etc., and although pressure for supplies for some trades is not so heavy, this has enabled the re-rollers to clear off more quickly the orders in arrears for users urgently in need of supplies. Export demands are on a good scale, and are much in excess of the tonnages which the re-rollers can undertake at present.

Home steelworks continue to send forward good tonnages of steel semis, but imports are scarce. Pressure is sustained on home suppliers, particularly for the smaller sized billets, as well as carbons and special quality steels.

Non-ferrous Metals

The non-ferrous metal markets continue to be dominated by day-to-day events in the Middle East. The position is still too fluid for confidence to oust uncertainty and prices remain susceptible to any fresh developments concerning the next step to be taken to resolve the problem. In these circumstances the general attitude is one of "wait and see" and the market is comparatively quiet.

With regard to copper, there is a definite reluctance to open up fresh commitments. Buying is only fair, but there is little selling and while the Suez situation may mean supplies are held up, the fact that the UK Government's metal from its stockpile is now beginning to come on the market, ensures ample supplies and is contributing to the surplus metal available. The immediate problem is, however, oil, not copper, and the impact of its growing scarcity on the consumption of copper—and of the other metals. Any relaxation of the political situation would undoubtedly see the copper price shade to lower levels. In the United States, primary producers and custom smelters are quoting 36 cents, with demand for foreign copper for export selling at 35½ cents a pound. Generally speaking, US trade circles have given up hope of the market reviving before the end of the year. Brass mills are operating well below rated capacity and new business booked is about the same as the current rate of delivery. The one bright factor in the situation is the news that automobile dealers have rid themselves of the 1956 models and that demand for 1957 models is reported to be good.

Although the tin price has moved to lower levels and the back has narrowed, there is no prospect of increased supplies. The number of ships sunk in the canal has now been reported as totalling 49. No precise estimate has been made as to the time it will take to clear these "wrecks," but the resumption of normal navigation through the canal is obviously going to require several months. In the meantime tinplate consumption is good both here and in America where new bookings are coming in satisfactory despite the higher prices.

Demand for lead in London is fair, but continues steady in the US at 16 cents a pound. Zinc is quietly steady both here and in New York. Demand for "Prime Western" at 13½ cents per pound East St. Louis remains good, although buying from diecasters is still disappointing.

Latest Foundry Statistics

According to the Ministry of Supply the output of aluminium-alloy castings during July was 1,746 tons from sand moulds, 3,002 tons from gravity-die and 1,041 tons from pressure-die-castings. A production of 250 tons of magnesium-alloy castings is reported.

As reported by the British Bureau of Non-Ferrous Metal Statistics, the output of copper-based castings during September was 6,496 tons. For the first nine months of this year, the production was 57,157 tons as against 57,604 last year. During this same period production of unalloyed copper castings rose from 4,500 to 5,850 tons.

THE 30th CONGRESS of the *Association Technique de Fonderie* will be held in Paris at the end of May and the beginning of June 1957.

BAKER PERKINS Shot Blast Equipment

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Engineers
WESTWOOD WORKS – PETERBOROUGH

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

November 21, 1956

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 11s. 0d.; Birmingham, £17 3s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £20 8s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £20 12s. 3d.

Scotch Iron.—No. 3 foundry, £21 14s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £23 16s. 6d.; South Zone, £23 19s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 4s. 0d.; South Zone, £25 6s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £21 7s. 6d.; Scotland (Scotch iron), Zone S. 1, £21 14s. 0d.; Sheffield, £22 14s. 6d.; Birmingham, £23 2s. 0d.; Wales (Welsh iron), £21 7s. 6d.

Basic Pig-iron.—£18 3s. 0d. all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £48 0s. 0d. to £50 5s. 0d., scale 16s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £73 2s. 6d., scale 16s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 27s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 12s. 3d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £250 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 16s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 19s. 0d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £93 10s. 0d. to £95 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; over 6 per cent. C, £92 10s. 0d. to £93 0s. 0d., basis 60 per cent. Cr, scale 29s. 9d. to 32s. 0d. per unit; 2 per cent. C,* 2s. 1d. per lb. Cr; 1 per cent. C,* 2s. 1½d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 6d. to 23s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £68 0s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £28 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £29 19s. 0d.; hard (0.41 to 0.60 per cent. C), £31 0s. 6d.; silico-manganese, £39 10s. 0d.; free-cutting, £33 3s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £36 14s. 6d., silico-manganese, £39 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £34 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £35 16s. 0d.; acid, up to 0.25 per cent. C, £38 17s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £35 7s. 0d.; boiler plates (N.-E. Coast), £37 17s. 0d.; floor plates (N.-E. Coast), £36 16s. 0d.; sectional material, N.-E. Coast, £33 16s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £36 3s. 0d.; flats, 5 in. wide and under (4-ton lots), £36 3s. 0d.; hoop and strip, £36 12s. 6d.; uncoated strip mill coils, not rolled, under 3mm. to 12g., £38 16s. 0d.; black sheets (hand mill), 17/20 g., £50 4s. 6d.; galvanized corrugated sheets, 24 g., £62 2s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £61 13s. 9d.; nickel-chrome, £85 10s. 6d.; nickel-chrome-molybdenum, £96 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £271 10s. 0d. to £272 0s. 0d.; three months, £272 10s. 0d. to £273 0s. 0d.; settlement, £272 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 9½d. per lb.; rods, 320s. 0d. per cwt. basis; 20 s.w.g., 355s. 3d. per cwt.

Tin.—Cash, £832 10s. 0d. to £835 0s. 0d.; three months, £825 0s. 0d. to £826 0s. 0d.; settlement, £845 0s. 0d.

Lead (Refined Pig).—Second half November, £118 0s. 0d. to £118 5s. 0d.; second half February, £115 15s. 0d. to £116 0s. 0d.

Zinc.—Second half November, £99 5s. 0d. to £99 15s. 0d.; second half February, £95 5s. 0d. to £95 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £133 0s. 0d.; rolled zinc (boiler plates), all English destinations, £130 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Brass Tubes, etc.—Solid-drawn tubes 2s. 3¾d. per lb.; rods, drawn, 3s. 1¾d.; sheets to 10 w.g., 238s. 0d. per cwt.; wire, 2s. 11¼d.; rolled metal, 238s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £205; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £250 HTB2 (38 tons), —; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £283; LG3 (86/7/5/2), £291; G1 (88/10/2/½), £350; (88/10/2/1), £340.

Phosphor Bronze.—BS1400, PB1 (AID released), £360 per ton.

Phosphor Bronze Strip, etc.—Strip, 341s. 3d. per cwt.; sheets to 10 w.g., 341s. 3d. per cwt.; wire, 4s. 5½d. per lb.; rods, 3s. 9½d.; tubes, 3s. 7½d.; chill cast bars: solids 3s. 9½d., cored 3s. 10½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 5½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 4½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £83 10s. 0d. Nickel, £519 0s. 0d. Aluminium ingots, £198 10s. 0d.; aluminium bronze (BS1400), AB1, £295; AB2, £307. Solder, brazing, BS1945 type 8 (50/50). 3s. 1d. per lb., type 9 (54/46), 3s. 4½d. per lb.

* Average 68–70 per cent.